Administrative Draft
Environmental Impact Statement

Betze Project
Barrick Goldstrike Mines, Inc.
Elko, Nevada

Prepared for

USDI Bureau of Land Management
Elko District Office
Elko, Nevada

August 1990

0739-001

ADMINISTRATIVE DRAFT ENVIRONMENTAL IMPACT STATEMENT

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1.0 INTRODUCTION AND PURPOSE AND NEED

1.1 Introduction

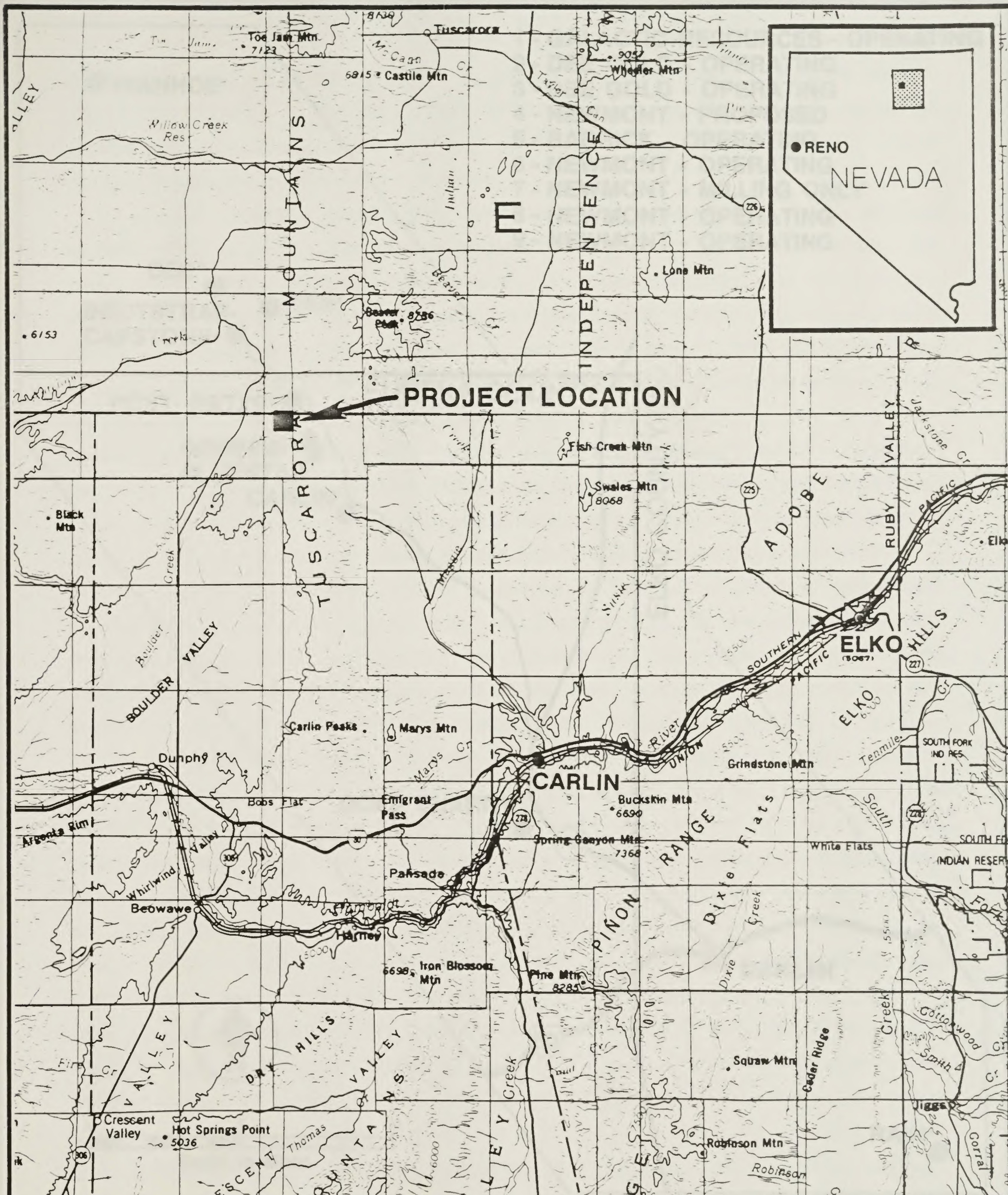
Barrick Goldstrike Mines Inc. (Barrick) proposes to continue and expand its existing gold mining and processing operations at the Goldstrike Mine in Eureka and Elko counties, Nevada. The existing and proposed activities are located on lands administered by the Elko Resource Area of the Bureau of Land Management (BLM) and on privately owned lands. In April 1989, Barrick submitted a Plan of Operations amendment to the BLM describing the proposal, known as the Betze Project. In accordance with 40 CFR 1501.4, BLM reviewed the proposal and determined that an environmental impact statement (EIS) was necessary. Therefore, the BLM is serving as the lead agency for preparation of an EIS in compliance with the National Environmental Policy Act of 1969 (NEPA). The U.S. Environmental Protection Agency (EPA) is serving as a cooperating agency.

This EIS has been prepared in compliance with NEPA, the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (40 CFR 1500-1508), and BLM's NEPA Handbook (9H-1790-1). It describes the components of, reasonable alternatives to, and environmental consequences of implementing the Betze Project. Its purpose is to assist BLM and the public in comparing the environmental impacts of a range of reasonable project alternatives.

The Betze Project involves the expansion of an existing open-pit mine to permit recovery of ore which contains approximately 15.1 million ounces of gold. It also includes the expansion of Barrick's existing processing facilities to process the ore mined from that deposit. The existing mine and processing facilities are located within a larger area that contains rich mineral deposits, some of which are being mined by parties other than Barrick. Figure 1-1 identifies the general location of the Betze Project. Figure 1-2 depicts the relationship of the Betze Project to nearby mining operations and mineral deposits.

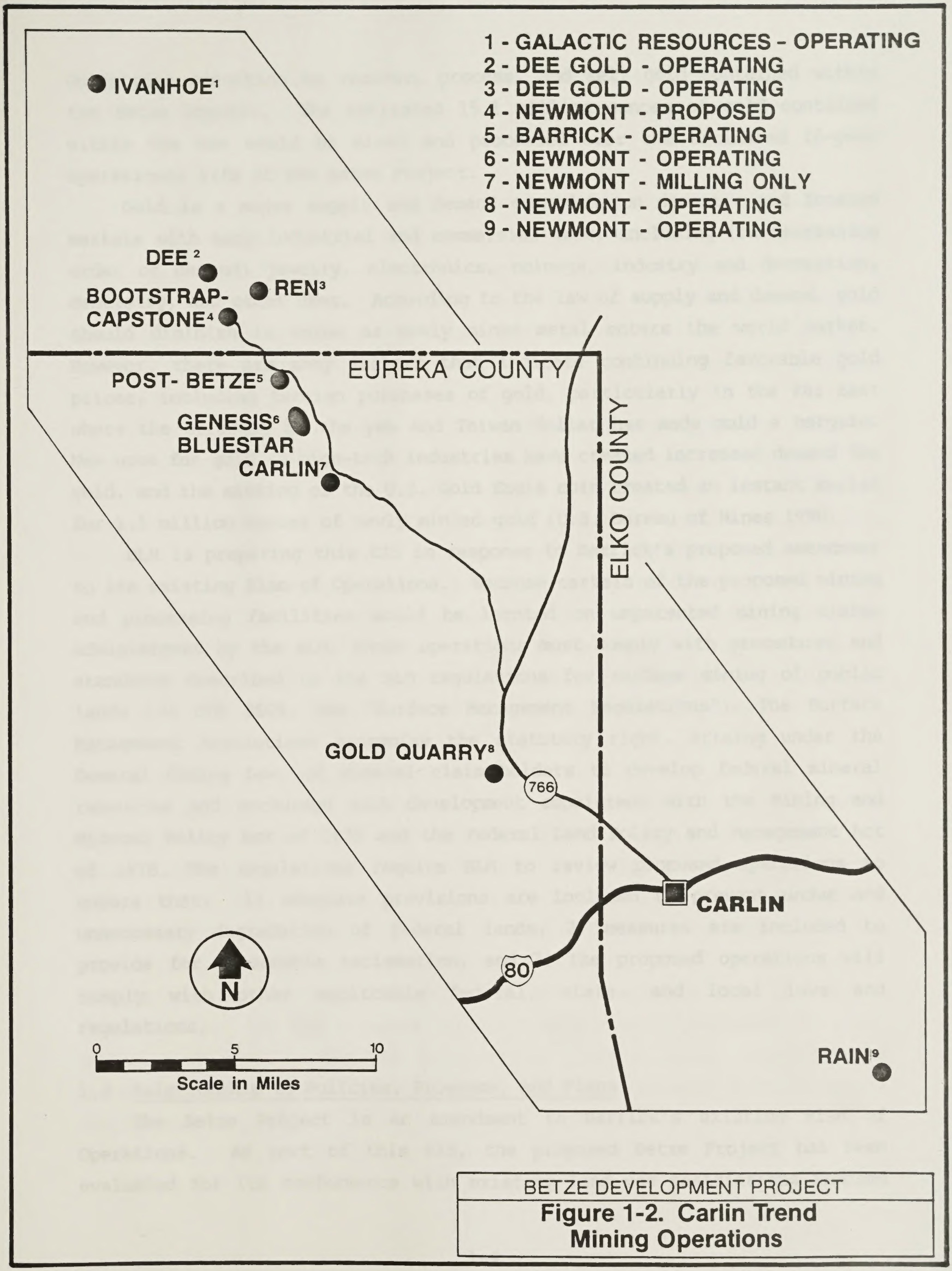
1.2 Purpose and Need

Barrick's purpose in proposing the Betze Project is to utilize and expand the existing workforce, capital equipment, and infrastructure of the



BETZE DEVELOPMENT PROJECT

Figure 1-1. Betze Project Location Map



BETZE DEVELOPMENT PROJECT

Figure 1-2. Carlin Trend Mining Operations

Goldstrike operation to recover, process, and sell gold contained within the Betze Deposit. The estimated 15.1 million ounces of gold contained within the ore would be mined and processed over the estimated 16-year operational life of the Betze Project.

Gold is a major supply and demand commodity on domestic and foreign markets with many industrial and commercial uses, including (in decreasing order of demand) jewelry, electronics, coinage, industry and decoration, dentistry, and other uses. According to the law of supply and demand, gold should diminish in value as newly mined metal enters the world market. However, there are many factors that indicate continuing favorable gold prices, including foreign purchases of gold, particularly in the Far East where the strength of the yen and Taiwan dollar has made gold a bargain. New uses for gold in high-tech industries have created increased demand for gold, and the minting of the U.S. Gold Eagle coin created an instant market for 1.5 million ounces of newly minted gold (U.S. Bureau of Mines 1990).

BLM is preparing this EIS in response to Barrick's proposed amendment to its existing Plan of Operations. Because certain of the proposed mining and processing facilities would be located on unpatented mining claims administered by the BLM, those operations must comply with procedures and standards described in the BLM regulations for surface mining of public lands (43 CFR 3809, the "Surface Management Regulations"). The Surface Management Regulations recognize the statutory right, arising under the General Mining Law, of mineral claim holders to develop federal mineral resources and encourage such development consistent with the Mining and Mineral Policy Act of 1970 and the Federal Land Policy and Management Act of 1976. The regulations require BLM to review proposed operations to ensure that: 1) adequate provisions are included to prevent undue and unnecessary degradation of federal lands; 2) measures are included to provide for reasonable reclamation; and 3) the proposed operations will comply with other applicable federal, state, and local laws and regulations.

1.3 Relationship to Policies, Programs, and Plans

The Betze Project is an amendment to Barrick's existing Plan of Operations. As part of this EIS, the proposed Betze Project has been evaluated for its conformance with existing land use restrictions imposed

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by Elko or Eureka counties or the State of Nevada and minerals decisions in BLM's Elko Resource Management Plan.

1.4 Authorizing Actions

In addition to the EIS, implementation of the proposed Betze Project or the alternatives would require authorizing actions from the BLM and other federal, state, and local agencies with jurisdiction over the project. Authorizing actions are land use or environmental permits, licenses, or approvals required for project construction or operation. Table 1-1 summarizes the authorizing actions required for the proposed Betze Project.

The reader will notice in the list of permits and approvals that some major permits usually associated with large projects are not necessary for the Betze Project. A Corps of Engineers Section 404 Permit is not necessary because Barrick can easily avoid disturbing Rodeo Creek. An EPA National Pollutant Discharge Elimination System (NPDES) Permit is not necessary because Barrick does not discharge any pollutants, only water which only requires treatment for arsenic to meet drinking water standards. An EPA Prevention of Significant Deterioration (PSD) air permit is not necessary because the project has only low levels of process emissions which are well below the threshold levels requiring a PSD permit.

1.5 Public Participation

The CEQ regulations require an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). To begin the scoping process, the lead agency publishes a Notice of Intent in the Federal Register. The BLM published Notices of Intent for the Betze Project in the Federal Register on April 19, 1989 and June 29, 1989. Formal public scoping meetings were held in Elko and Reno, Nevada on July 19 and 20, respectively. The BLM accepted scoping comments until September 5, 1989. During that period, the BLM received 11 comment letter regarding the proposed Betze Project. The scope of this EIS reflects input from the public scoping process.

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TABLE 1-1

REGULATORY REQUIREMENTS

Authorizing Action	Regulatory Agency
Approval of Plan of Operations	BLM
National Environmental Policy Act Compliance	BLM
Archaeological Site Clearance	BLM and Nevada State Historic Preservation Office (SHPO)
Industrial Artificial Pond Permit	Nevada Department of Wildlife
Appropriation Permit	State Engineer
Water Pollution Control Discharge Permit	Nevada Department of Environmental Protection (NDEP)
Air Quality Registration Certificate and Permit to Operate	NDEP
Solid Waste Permit	NDEP
Water and Sewage System Approvals	Nevada Division of Health, Department of Human Resources
Safety Plan with reporting and notification schedule	Mine Safety and Health Administration (MSHA)

2.0 PROPOSED ACTION AND ALTERNATIVES

This chapter provides a description of the action proposed by Barrick and a range of reasonable alternatives. The major issues and concerns identified throughout the scoping process, issues identified by affected agencies and pertinent legal authorities, and agency policies were used in the development of alternatives. Section 2.1 describes Barrick's existing operations to establish the context for the description of the proposed action and alternatives. Section 2.2 describes the proposed Betze Project. Section 2.3 describes the alternatives considered in detail by BLM, the alternatives eliminated from detailed consideration, and the no-action alternative. Section 2.4 is a summary of the environmental impacts and discussion of mitigation measures relating to the proposed action and the alternatives.

2.1 Existing Operations

This section describes the existing Goldstrike Mine operations to establish the context for the description of the proposed expansion of operations contained in Section 2.2. There are other existing gold mining operations in the vicinity of the Goldstrike Mine. These operations are addressed in the discussion of the existing environment in Chapter 3.0.

2.1.1 Location and Land Ownership

Barrick's existing gold mining operations are located in the Tuscarora Range in north-central Nevada. The mining operations are located in Township 36 North, Range 49 East and Township 36 North, Range 50 East, approximately 25 miles northwest of the town of Carlin, Nevada, as shown in Figure 2-1. The Goldstrike Mine is sited in the Little Boulder Basin, a topographic feature which contains the drainage of Brush, Rodeo, and Bell creeks. Brush and Bell creeks drain to Rodeo Creek. Rodeo Creek converges with Boulder Creek in northern Boulder Valley west of the project area. Elevations at the project range from 5,100 feet above mean sea level (AMSL) in the foothills of Boulder Valley, to 5,926 feet AMSL in the highest portion of the Betze Project area which contains the open-pit mining operations. Little Boulder Basin is bounded on the east by the 6,000 to 7,500-foot Tuscarora Mountains, a north-trending range typical of the Basin and Range physiographic province. Little Boulder Basin is bounded on the

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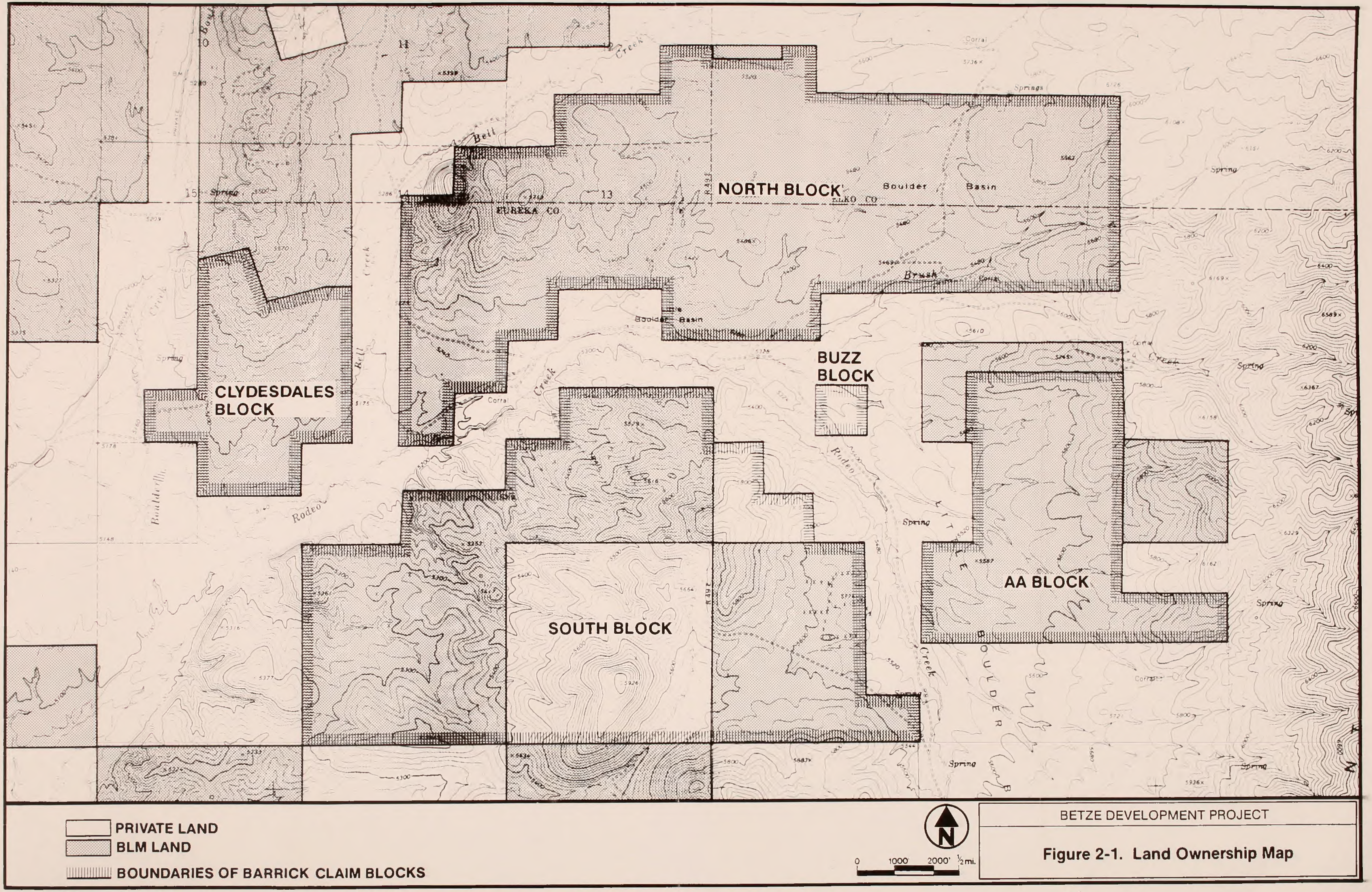


BETZE DEVELOPMENT PROJECT

Figure 2-1. Land Ownership Map

west by Boulder Creek and Boulder Valley. The area affected by the project is described in more detail in Chapter 3.0.

The Goldstrike Mine is owned by Barrick, a subsidiary of American Barrick Resources Corporation. A map depicting the land ownership in the area is shown in Figure 2-1. The mine is located principally on unpatented mining or millsite claims on public lands, although some operations at the mine occur on private lands. The property consists of several non-contiguous blocks which total approximately 6,475 acres. The approximate acreage for each block is shown below:

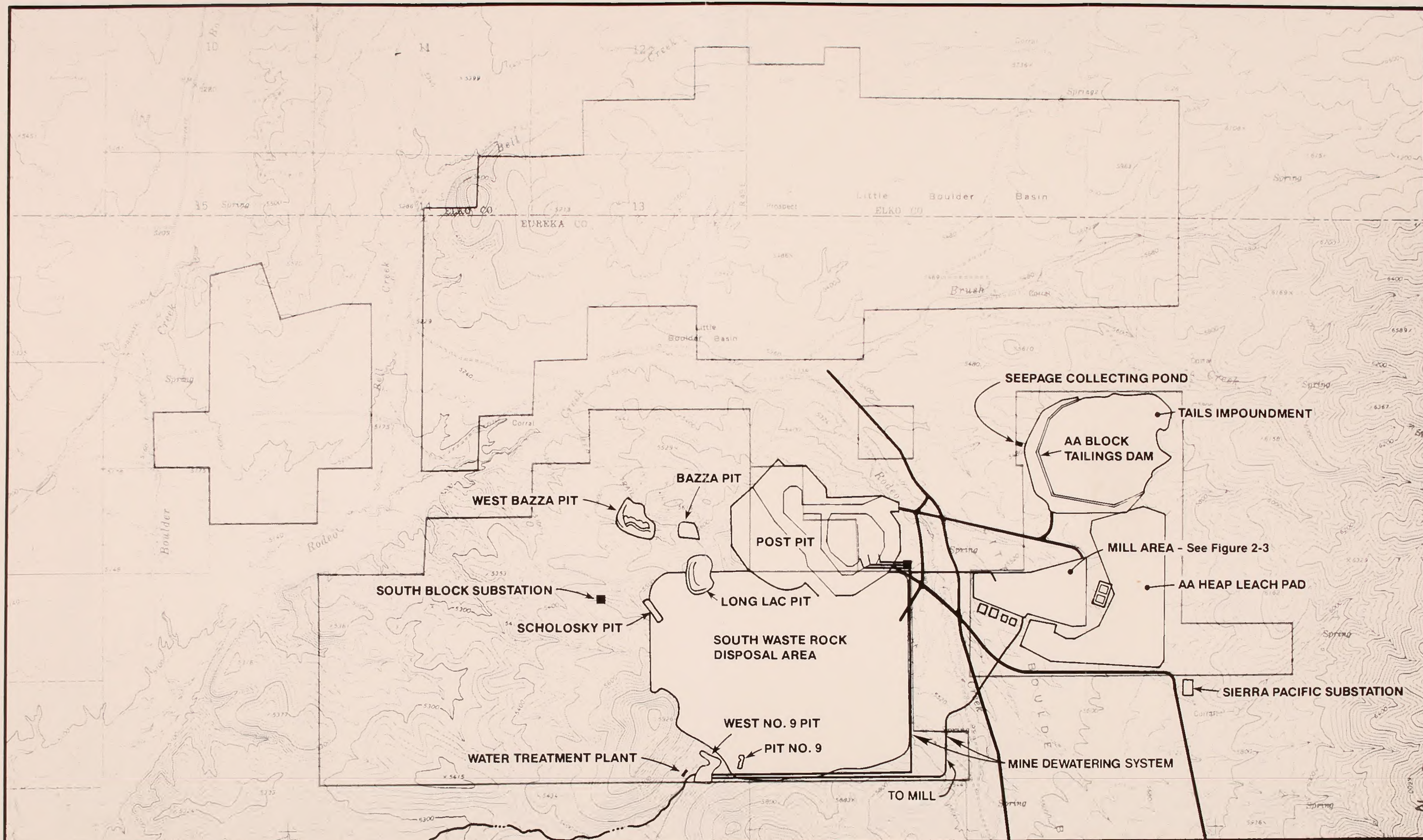
South Block	2,443 acres
North Block	2,590 acres
AA Block	856 acres
Clydesdales Block	546 acres
Buzz Block	40 acres

The majority of the lands immediately surrounding Barrick's holdings are private lands owned by subsidiaries of Newmont Mining Corporation, including Newmont Gold Company ("Newmont") and the Elko Land and Livestock Company (ELLCO). ELLCO and another company operate the TS Ranch, which grazes cattle on a large area surrounding the Betze Project area.

2.1.2 History of Exploration and Mining Operations at the Goldstrike Mine and Surrounding Area

Gold was first discovered in the Carlin area in 1907 (Kilborn Ltd. 1988). The Big Six Mining Company constructed the first gold processing plant on the Carlin Trend in 1913 (Kilborn Ltd. 1988). Currently, several mining operations, consisting of open pits, crushers, mills, tailings ponds, heap leach facilities, and waste rock disposal areas, are located in Little Boulder Basin. Figure 1-2 shows the locations of these projects and others along the Carlin Trend. The nearest active mining operation is Newmont's Genesis Mine, located approximately 1.0 mile south of the South Block. The nearest mill to the Goldstrike Mine is Newmont's Mill No. 4, located adjacent to the north side of the AA Block. Newmont's North Area heap leach pads are located adjacent to and south of the AA Block. Gold Production of Barrick and Newmont in the Little Boulder Basin in 1989 totalled approximately 473,000 ounces.

Western States Minerals Joint Venture (Western States), Barrick's predecessor at the Goldstrike Mine, had been operating the mine since the late 1970s. Western States first filed a Plan of Operations with BLM for



BETZE DEVELOPMENT PROJECT

Figure 2-2. Site Plan - Existing Facilities

surface disturbance of federal lands in 1981, shortly after BLM began requiring such plans. Western States subsequently amended the Plan of Operations on several occasions, as required, to expand its open-pit mining of several deposits at the mine and for its heap leaching activities. The Plan of Operations amendments allowed the mining of various deposits, the most important of which is the Post Pit, and allowed the construction and operation of heap leach pads and related mining and processing facilities for gold recovery. Barrick acquired Western States' interest in the Goldstrike Mine in December 1986. Barrick then submitted a Plan of Operations amendment (Barrick 1987) to the BLM for authorization to construct a mill and tailings impoundment to augment the previously approved heap leach and related facilities operated by Western States. BLM approved this Plan of Operations amendment in December 1987.

During early 1987, Barrick made the first of a series of significant gold discoveries on the Goldstrike Property. A Plan of Operations amendment for expansion of mining and continued exploration drilling on the South Block (Barrick 1988a) was approved by BLM in 1989. This amendment authorized expansion of the Post Pit, mining of additional ore reserves in satellite pits, the expansion of the South Waste Rock Disposal Area, the initiation of mine dewatering operations, construction of a 1,500-ton per day (tpd) autoclave, and additional exploration drilling. Figure 2-2 depicts existing mining operations at the Goldstrike Mine. Appendix A contains a list of previous plans of operations and their amendments.

As Barrick continued to mine the Post Deposit, it also continued to explore the area in and around the Post Pit. Barrick drilled approximately 220 holes and ultimately defined approximately 15.1 million ounces of gold in the Betze Deposit. The Betze Deposit is distinguishable from deposits presently being mined in the immediate area chiefly because of its size, relatively high grade, and "sulfide" ore characteristics. Of the 15.1 million ounces, approximately 13.0 million ounces are sulfide ore, as defined by Barrick. During 1989-1990, Barrick and Newmont discovered or defined a number of other smaller but significant mineralized areas beneath or near the Betze Deposit. These mineralized areas include the Deep Post, Deep Star, Screamer, Rodeo, and Purple Vein. At the present time, no development of these mineralized areas has been proposed by the various claim holders.

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2.1.3 Existing Mining Operations

Barrick currently operates the Post Pit and other much smaller pits as shown in Figure 2-2. Approximately 325,000 tons of ore and waste per day are moved using electric shovels, front-end loaders, and haul trucks; this includes approximately 25 million tons per year of material that Barrick mines under contract with Newmont from a portion of the Post Pit located on Newmont's property. Barrick continues to operate, from time to time, open pits (Bazza, West Bazza, Long Lac, etc.) originally developed by Western States. Barrick is also mining small satellite pits (Winston Pit) using independent mining contractors.

The Post Pit has reached a depth of approximately 300 to 700 feet below the surrounding surface. The primary objective in Barrick's open pit slope design is to produce safe highwall slopes which also will achieve maximum economic recovery of the ore reserve. Slope stability in the Post Pit is very sensitive to the orientation of major fault structures. The primary structural trend strikes north-northwest and dips steeply either westward or eastward in association with the regional, Basin and Range type faulting. Wide fault zones, characterized by weak rock conditions, have this orientation. Zones of argillization and silicification also tend to follow this trend as mapped in the Post Pit. Highwalls which are aligned nearly parallel to the trend are less stable than slopes more oblique to the trend. Another geologic factor of concern in pit slope design is that significant alteration of the rock mass is associated with the intrusive-sediment contact. Strong zones of argillization may contribute to weak rock mass conditions in these zones, and slopes may have to be locally flattened to compensate.

Many of the fault zones and alteration zones are wide enough to be considered distinct geologic units. Therefore, slope design is on a sector-by-sector basis according to the geometric location of the highwalls with respect to geologic structures. The pit has been divided into ten sectors for design purposes. Experience in the Post Pit has shown that the north and south walls may be mined to an overall height of 360 feet at an interramp slope angle of 47.5 degrees. East and west highwalls were previously found to be unstable at that slope angle, and these highwalls are currently being mined at an interramp slope angel of 39 degrees. Using these design parameters, Barrick uses a double bench layout with 25-foot wide catch benches on the steeper slopes and 30-foot wide catch benches on

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The Post Pit has reached a depth of approximately 700 to 750 feet below the surrounding surface. The primary objective in Barrick's open pit slope design is to produce safe highwall slopes which also will achieve maximum economic recovery of the ore reserve. Slope stability in the Post Pit is very sensitive to the orientation of major fault structures. The primary structural trend strikes north-northwest and dips steeply either westward or eastward in association with the regional, Basin and Range type faulting. Wide fault zones, characterized by weak rock conditions, have this orientation. Zones of argillization and silicification also tend to follow this trend as mapped in the Post Pit. Highwalls which are aligned nearly parallel to the trend are less stable than slopes more oblique to the trend. Another geologic factor of concern in pit slope design is that significant alteration of the rock mass is associated with the intrusive-sediment contact. Strong zones of argillization may contribute to weak rock mass conditions in these zones, and slopes may have to be locally flattened to compensate.

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the flatter slopes. The existing surface disturbance of the Post Pit itself is approximately 205 acres. Table 2-1 lists the approximate acreages disturbed by Barrick's existing mining and processing operations. Table 2-2 shows the existing mining equipment schedule.

It must be noted that whenever this EIS references an elevation, the elevation base datum is one established by Barrick. There are discrepancies among the three survey systems currently in use in the area (Barrick, Newmont, and U.S. Geological Survey); for consistency, this document is based on Barrick's survey and elevations.

Ore and waste rock are drilled and blasted with conventional commercial explosives. The blasted rock is excavated by front-end loaders or shovels and loaded into 85-ton, 100-ton, or 190-ton capacity haul trucks. Waste rock is trucked to the South Waste Rock Disposal Area, to Newmont property, or to mine construction projects. Newmont ore is hauled to Newmont processing facilities or to ore stockpiles. Barrick ore is trucked approximately 3.0 miles to ore stockpiles or to the processing facilities on the AA Block. Mill-grade ore is sent to the mill circuit. Leach ore is either sent to the crushing and agglomeration circuit or is hauled directly to the AA Block leach pads as run-of-mine ore. Topsoil stripped during mining is stored in piles as depicted in Figure 2-2.

The Post Pit is being dewatered using in-pit wells, perimeter wells, and in-pit sumps. The quantity of dewatering water has varied from 0 to 4,000 gallons per minute (gpm). Up to 2,000 gpm of water from dewatering operations is used for mining and milling purposes, including process system makeup, mine operations, dust control, exploration drilling, and construction. Water not required for mining and milling purposes is pumped from the Post Pit area and discharged via an unnamed drainage to the TS Ranch Reservoir, located approximately 4.5 miles southwest of the Goldstrike Mine. That reservoir was constructed in late 1989 to store water developed from area mining operations of Barrick and Newmont for eventual use by the TS Ranch Joint Venture for agricultural purposes. Erosion control structures have been constructed in the unnamed drainage and the drainage has been rip rapped upstream to minimize erosion and sedimentation.

Dewatering water from Barrick's operations is treated prior to release using a ferric sulfate solution to eliminate naturally occurring arsenic.

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TABLE 2-1

EXISTING FACILITY DISTURBANCE

Facility	Acreage
Heap Leach Pads	80.6
AA Tailings Impoundment	234.2
South Block Waste Rock Area	490.0
Post Pit	205.0
Other Small Pits	125.0
Mill Site	23.9
Administration/Operations Buildings	25.0
Topsoil Stockpiles (14 sites)	75.5
Total Existing Disturbance	1,259.2

TABLE 2-2

EXISTING MINE EQUIPMENT

Equipment Type		Number[1]
Shovels	Front-end Loader - 13.5 cubic yards	4
	Hydraulic - 13.5 cubic yard	3
	Hydraulic - 23.5 cubic yard	2
	Electric - 40 cubic yard	0
Haul Trucks	85 ton	18
	100 ton	12
	190 ton	8
Front End Loaders	FEL - 13.5 cubic yard	4
Blast Hole Drills	40,000 lb rating	4
	60,000 lb rating	2
	Long Hole Rig	0
Rubber-Tired Dozer	35 ton	3
	51 ton	3
Tracked Dozers	37 ton	3
	62 ton	6
Road Graders	14 G and 16 G classes	5
Water Trucks	11,000 gallon capacity	2
	16,000 gallon capacity	0
Scrapers	30 cubic yard	2
Backhoes	6 cubic yard	1
Crane	40 ton	1
	150 ton	1

[1] First quarter 1989.

Treatment was installed after water quality tests showed arsenic to be the only metal occurring in concentrations above levels specified in Barrick's existing discharge permit.

Water trucks are used to suppress dust on the roads and waste rock disposal area. During dry periods, an estimated 100,000 gallons of water per hour are distributed on road surfaces. In addition, dust suppression on the roads is accomplished through the application of a magnesium chloride solution and the operation of a sprinkler pipeline located on the main haul road from the mining operations on the South Block to the processing facilities on the AA Block. Additionally, Barrick implements all the mitigation measures identified in earlier NEPA documents prepared for previous approvals (see Appendix A).

Air Monitoring Station. In October 1989, Barrick installed an air quality and meteorological monitoring station in the North Block, approximately 1.5 miles north-northwest of the mill. That station monitors wind speed and direction, temperature, relative humidity, precipitation, evaporation, and PM-10 and the data are gathered every 6 days. The air quality and meteorological data are used to model the projected impacts of the proposed mine and mill.

2.1.4 Existing Processing Operations

2.1.4.1 Heap Leaching Operations. In 1989, Barrick recovered over 96,950 ounces of gold at the Goldstrike Mine by heap leaching. The existing heap leach operation is a closed-loop circuit. A leach solution is applied to ore heaps and collected and pumped to the gold recovery facility. After gold recovery, the leach solution is recycled back to the heaps. The facilities for recovery of gold from heap leaching operations are self-contained and are separate from the milling operations. The specific components of the heap leaching operation include:

- Crushing and Agglomeration. Leach grade ore is hauled to the gyratory crusher system for size reduction and agglomeration. The gyratory crusher, which can process up to 1,750 tons per hour, reduces the ore to less than 5-inch size. Cement is added after primary crushing to agglomerate the fine material to enhance percolation of solution through the heap. The leach ore is further reduced to less than 1.25-inch size in the secondary impact crusher. Ore from the crushing circuit is stored in a

Treatment was installed after water quality tests showed arsenic to be the only metal occurring in concentrations above levels specified in Barrick's existing discharge permit.

Water trucks are used to suppress dust on the roads and waste rock disposal area. During dry periods, an estimated 100,000 gallons of water per hour are distributed on road surfaces. In addition, dust suppression on the roads is accomplished through the application of a magnesium chloride solution and the operation of a sprinkler pipeline located on the main haul road from the mining operations on the South Block to the processing facilities on the 7A Block. Additionally, Barrick implements all the mitigation measures identified in earlier NEPA documents prepared for previous approvals (see Appendix A).

Air Monitoring Station. In October 1989, Barrick installed an air quality and meteorological monitoring station in the North Block, approximately 1.5 miles north-northwest of the mill. That station monitors wind speed and direction, temperature, relative humidity, precipitation, evaporation, and PM-10 and the data are gathered every 5 days. The air quality and meteorological data are used to model the projected impacts of the proposed mine and mill.

2.1.4 Existing Processing Operations

2.1.4.1 Heap Leaching Operations. In 1989, Barrick recovered over 96,050 ounces of gold at the Goldstrike Mine by heap leaching. The existing heap leach operation is a closed-loop circuit. A leach solution is applied to ore heaps and collected and pumped to the gold recovery facility. After gold recovery, the leach solution is recycled back to the heaps. The facilities for recovery of gold from heap leaching operations are self-contained and are separate from the milling operations. The specific components of the heap leaching operation include:

- a. Crushing and Agglomeration. Leach grade ore is hauled to the gyratory crusher system for size reduction and agglomeration. The gyratory crusher, which can process up to 1,750 tons per hour, reduces the ore to less than 8-inch size. Cement is added after primary crushing to agglomerate the fine material to enhance percolation of solution through the heap. The leach ore is further reduced to less than 1.25-inch size in the secondary impact crusher. Ore from the crushing circuit is stored in a

30,000-ton ore stockpile prior to truck delivery to the AA Block Leach Pads. The AA Block leach pads also receive lower-grade oxide ore directly as run-of-mine ore. Existing heap leach pads and those approved by BLM but not yet constructed are shown in Figure 2-2.

- Leaching. A dilute cyanide solution (0.025 to 0.05 percent) is applied to the ore on the leach pads and percolates through the heap to a synthetic liner, extracting the gold. The gold-rich solution, known as pregnant solution, is collected in the pregnant solution ponds and pumped to the gold recovery facility.

- Adsorption. The gold recovery facility contains activated carbon columns through which the pregnant solution is pumped. The gold in the solution adsorbs onto the activated carbon leaving a barren solution. The barren solution is then recirculated back to the heaps after cyanide and caustic makeup is added to maintain adequate cyanide concentrations and pH control.

- Desorption (Carbon Stripping). The loaded carbon is removed from the columns on a daily basis and is sent to the stripping circuit. The gold is stripped from the carbon with a heated strip solution of 0.1 percent sodium cyanide and 2 percent sodium hydroxide.

- Electrowinning and Refining. The gold bearing strip solution is pumped to the electrowinning circuits where the gold is precipitated out of solution on steel wool cathodes. The gold-loaded steel wool cathodes are placed in a mercury retort to remove any mercury. Following the mercury retort, the dry cathodes and appropriate fluxes are charged into a gas-fired furnace for refining. The gold is produced as either 500- or 1,000-ounce gold dore' bars.

- Carbon Reactivation. After the loaded carbon has been stripped of its gold, it is pumped to a reactivation kiln feed screen where it is dewatered. Organic contaminants are removed from the screened carbon in a propane-fired reactivation kiln. The reactivated carbon discharges from the kiln into a quench tank, from which it is educed to a reactivated carbon wash screen. The screened reactivated carbon is recycled back to the adsorption circuit. Fine carbon from the reactivated carbon wash screen is collected in a wash settling pond, dried, and sent to an off-site smelter to remove any remaining gold.

2.1.4.2 <u>Milling Operations</u>. In 1989, Barrick recovered over 110,250 ounces of gold at the Goldstrike Mine through its mill. The existing mill, though of a nominal 4,500 tpd design capacity, has demonstrated the capacity to process approximately 6,000 tpd of material. The mill is composed of crushing, grinding, pressure oxidation, leaching, gold recovery, and refining circuits. Approximately 25 percent of the mill ore

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2.1.4.2 Milling Operations. In 1989, Barrick recovered over 116,500 ounces of gold at the Goldstrike Mine through its mill. The existing mill, though of a nominal 4,500 tpd design capacity, has demonstrated the capacity to process approximately 6,000 tpd of material. The mill is composed of crushing, grinding, pressure oxidation, leaching, gold recovery, and refining circuits. Approximately 25 percent of the mill ore

is characterized by Barrick as sulfide ore. Only the sulfide ore is processed through the mill's pressure oxidation circuit. A site plan of the existing milling facilities is shown in Figure 2-3, and the existing mill is illustrated in Figure 2-4. The specific components of the milling operation include:

- Crushing. Mill grade ore is reduced to a nominal 5-inch size in the jaw crusher. The crushed ore is stored in a 7,500-ton capacity stockpile. The ore is reclaimed by underground feeders and fed to the mill.

- Grinding. The grinding circuit in the existing mill consists of a semi-autogenous (SAG) mill and two ball mills operating in closed circuit with classifying cyclones. Pebble lime and water is added to the SAG mill feed for pH control. The resultant slurry is approximately 35 to 40 percent solids, with 80 percent of the solids passing 150 mesh.

- Pressure Oxidation. Oxide and sulfide ore slurries are processed through the leaching circuit separately. The oxide ore slurry is sent directly to the carbon-in-leach (CIL) circuit. The sulfide ore slurry is sent to the 1,500 tpd pressure oxidation circuit after thickening and acidulation using sulfuric acid. The sulfide ore slurry is then pumped to a pressure oxidation (autoclave) vessel operating at a temperature of approximately 440°F and a pressure of approximately 455 pounds per square inch (psi). Oxygen from a 175 tpd oxygen plant is sparged into the sulfide ore slurry in the autoclave to oxidize the sulfide minerals. The oxidized ore slurry that is discharged from the autoclave is treated with lime to increase the pH, and is then pumped to the CIL circuit. Additional discussion of the pressure oxidation circuit may be found in subsection 2.2.3.

- Carbon-in-Leach Processing. The CIL circuit performs two functions: cyanide solution dissolves the gold that is contained in the finely-ground ore slurry, and the gold that is contained in the cyanide solution is adsorbed onto carbon particles which are mixed with slurry. These actions proceed simultaneously.

- Carbon Stripping. The loaded carbon is screened out of the slurry and sent to the stripping circuit, which is identical to the stripping circuit described in subsection 2.1.4.1.

- Electrowinning and Refining. Following stripping, the gold is removed from strip solution by electrowinning and plated onto steel wool cathodes. The gold-loaded cathodes are retorted and refined. This process is the same as that described in subsection 2.1.4.1.

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- Pressure Oxidation. Oxide and sulfide ore slurries are processed through the leaching circuit separately. The oxide ore slurry is sent directly to the carbon-in-leach (CIL) circuit. The sulfide ore slurry is sent to the 1,500 tpd pressure oxidation circuit after thickening and acidulation using sulfuric acid. The sulfide ore slurry is then pumped to a pressure oxidation (autoclave) vessel operating at a temperature of approximately 440°F and a pressure of approximately 455 pounds per square inch (psi). Oxygen from a 215 tpd oxygen plant is sparged into the sulfide ore slurry in the autoclave to oxidize the sulfide minerals. The oxidized ore slurry that is discharged from the autoclave is treated with lime to increase the pH, and is then pumped to the CIL circuit. Additional discussion of the pressure oxidation circuit may be found in subsection 2.2.3.

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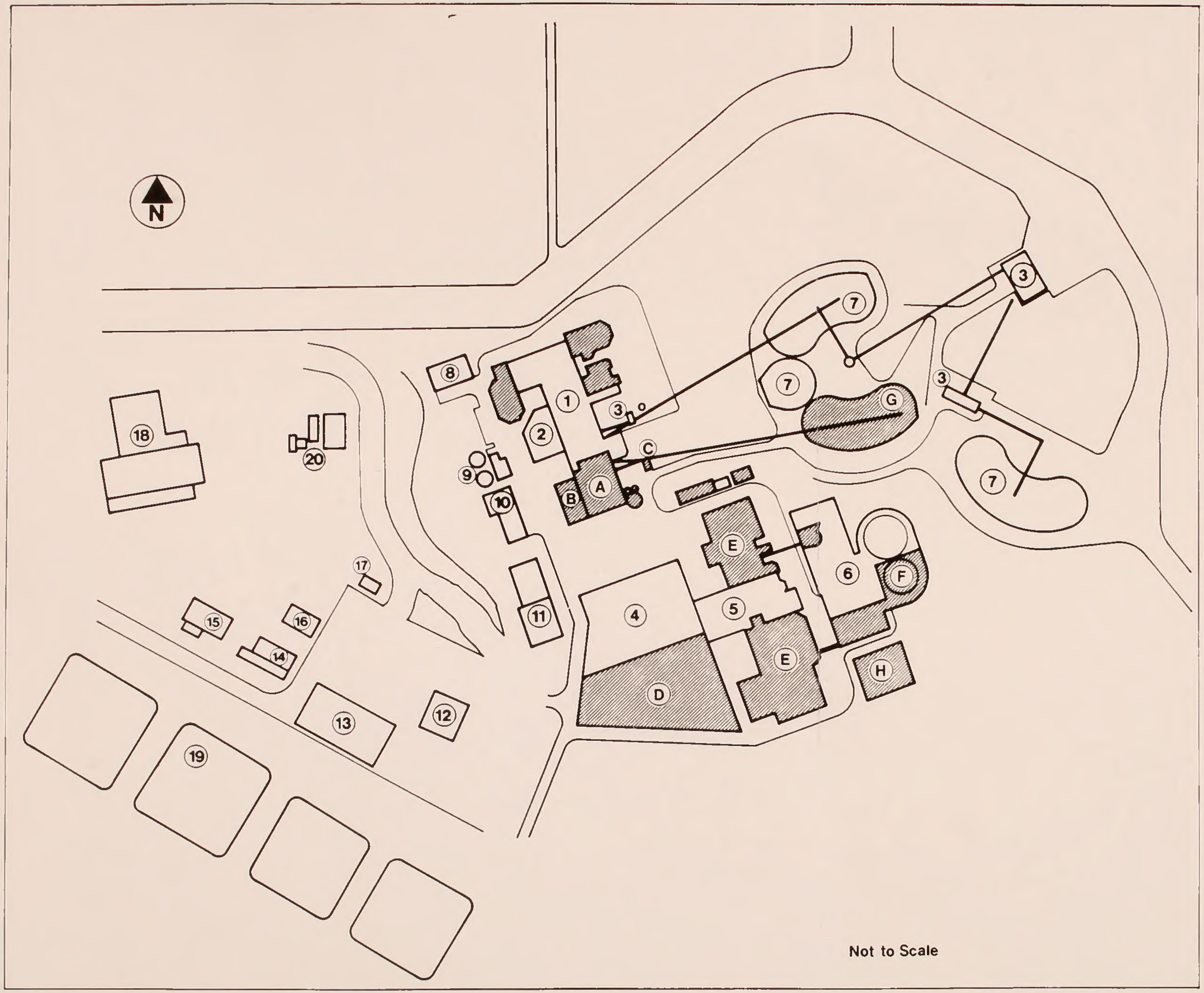
- Carbon Stripping. The loaded carbon is screened out of the slurry and sent to the stripping circuit, which is identical to the stripping circuit described in subsection 2.1.4.2.

- Electrowinning and Refining. Following stripping, the gold is removed from strip solution by electrowinning and plated onto steel wool cathodes. The gold-loaded cathodes are retorted and refined. This process is the same as that described in subsection 2.1.4.1.



EXISTING FACILITIES

1. Concentrator and CIL Tanks
2. Mill Substation
3. Crushers
4. Oxygen Plant
5. Autoclave
6. Solution Tanks
7. Ore Stockpiles
8. Propane Tanks
9. Water Supply
10. Maintenance Shops
11. Contractor Office and Warehouse
12. Administration Building
13. Technical Services
14. Laboratory
15. ADR Building
16. Sample Storage
17. Fuel Storage
18. Shops and Warehouse
19. Solution Ponds
20. Vehicle Wash

PROPOSED FACILITIES

A. Grinding and Concentrator
B. Mill Substation
C. Crusher
D. Oxygen Plant
E. Autoclaves
F. Solution Tank
G. Ore Stockpile
H. Propane Tanks

BETZE DEVELOPMENT PROJECT

Figure 2-3. Sulfide Mill and Ancillary Facilities

Figur

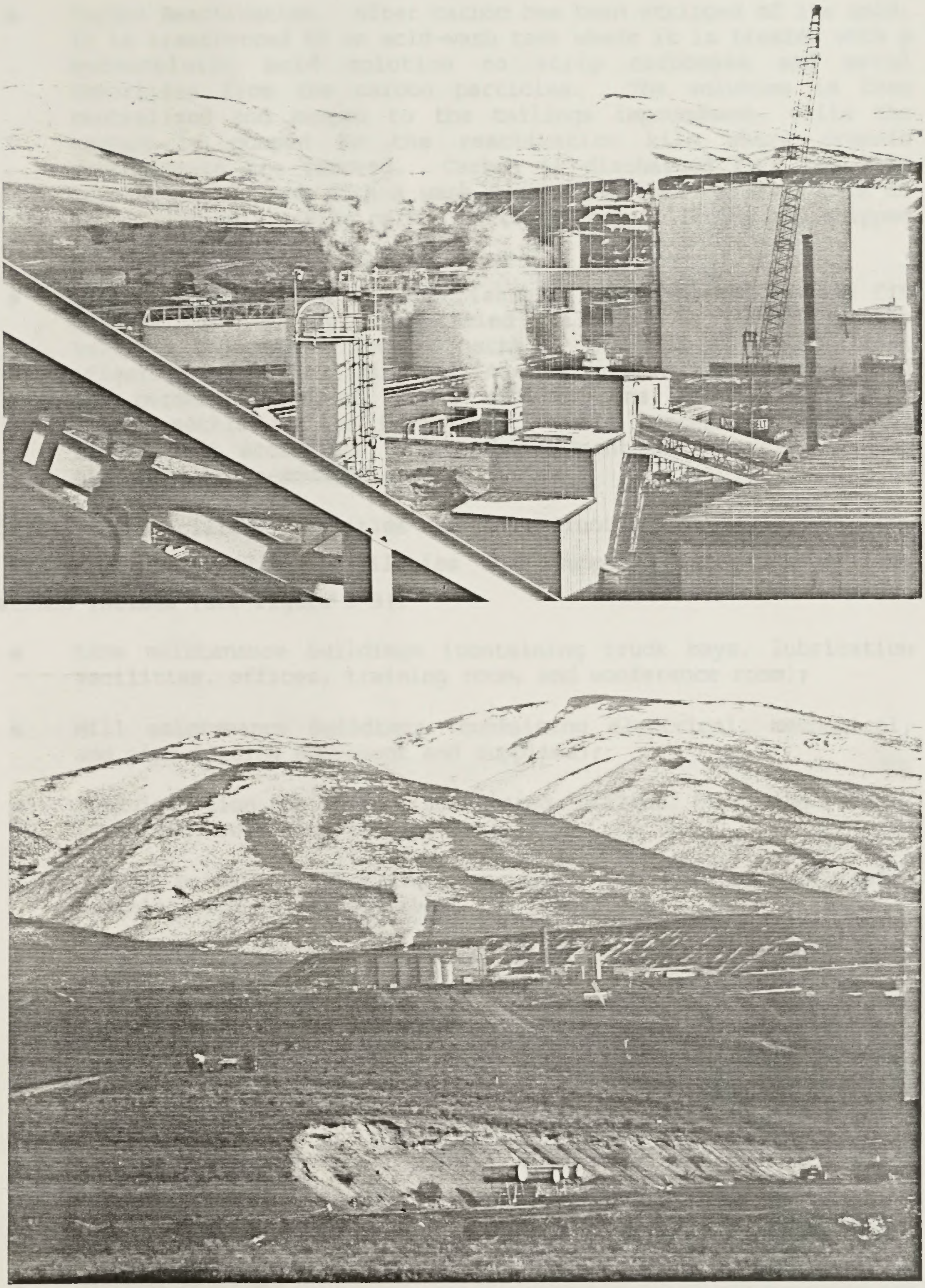


Figure 2-4. Photograph of Existing Goldstrike Mill

- Carbon Reactivation. After carbon has been stripped of its gold, it is transferred to an acid-wash tank where it is treated with a hydrochloric acid solution to strip carbonate and metal impurities from the carbon particles. The solution is then neutralized and pumped to the tailings impoundment, while the carbon is pumped to the reactivation kiln where organic contaminants are removed. Carbon is discharged from the kiln into a quench tank with a wash screen and then recycled back to the CIL circuit. Fine carbon particles are collected and shipped to an off-site smelter.

- Tailings Impoundment. After leaching is completed in the CIL circuit, the slurry, now called tailings, is pumped to the tailings impoundment located north of the mill on the AA Block (Figure 2-2). The existing tailings impoundment has been designed for permanent storage of 28 million tons of mill tailings. Solids settle in the impoundment, while process solution and runoff that accumulate in the impoundment are recycled to the mill by a barge-mounted pumping system.

2.1.5 Existing Ancillary Facilities and Infrastructure

The existing ancillary facilities that support mining and milling operations include (see Figure 2-3):

- Mine maintenance buildings (containing truck bays, lubrication facilities, offices, training room, and conference room);

- Mill maintenance buildings (containing electrical, mechanical, and pipe fitting equipment and supplies);

- Administration building (containing offices, training rooms, conference room, and storage vault);

- Safety buildings (containing supplies and training materials, training room, first aid room, and laboratory);

- Warehouse (covered storage of 30,000 square feet plus open storage);

- Assay laboratory and sample storage building;

- Electric utilities including substations and powerlines. Electrical power is provided by Sierra Pacific from the Boulder Basin substation at the southeast corner of the AA Block. Barrick has constructed a Mill substation and a South Block substation.

- Water supply (several wells, a pump house, and piping network);

- Propane storage;

- Sewage treatment (septic treatment plant with leach field backup);

- Carbon Reactivation. After carbon has been stripped of its gold, it is transferred to an acid-wash tank where it is treated with a hydrochloric acid solution to strip carbonate and metal impurities from the carbon particles. The solution is then neutralized and pumped to the tailings impoundment, while the carbon is pumped to the reactivation kiln where organic contaminants are removed. Carbon is discharged from the kiln into a quench tank with a wash screen and then recycled back to the CIL circuit. Fine carbon particles are collected and shipped to an off-site smelter.

- Tailings Impoundment. After leaching is completed in the CIL circuit, the slurry, now called tailings, is pumped to the tailings impoundment located north of the mill on the AA Block (Figure 2-4). The existing tailings impoundment has been designed for permanent storage of 20 million tons of mill tailings. Solids settle in the impoundment, while process solution and runoff that accumulate in the impoundment are recycled to the mill by a barge-mounted pumping system.

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The existing ancillary facilities that support mining and milling operations include (see Figure 2-3):

- Mine maintenance buildings (containing truck bays, lubrication facilities, offices, training room, and conference room);

- Mill maintenance buildings (containing electrical, mechanical, and pipe fitting equipment and supplies);

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- Assay laboratory and sample storage building;

- Electric utilities including substations and powerlines. Electrical power is provided by Sierra Pacific from the Boulder Basin substation at the southeast corner of the AA Block. Barrick has constructed a Mill substation and a South Block substation.

- Water supply (several wells, a pump house, and piping network);

- Propane storage;

- Sewage treatment (septic treatment plant with leach field backup);

- Fuel storage (gasoline and diesel);
- Roads (mining and exploration roads substantially affect all of the lands contained in the South Block);
- Communications (microwave system with 24 channels);
- Explosives Storage (isolated bermed magazine in Section 30, T36N, R50E); and
- Gatehouse (security offices, visitor reception, parking, and truck scale).

The following is a breakdown of employees, by department, as of the Second Quarter 1990:

Barrick Personnel Summary

Department	Number of Employees
Mine	612
Process	232
Administration	185
Total	1,029

In addition, there are approximately ____ persons employed by the mining contractors for blasting and satellite open-pit mining operations, and approximately _____ persons employed by construction contractors.

Barrick provides bus transportation for its employees to and from the mine. Barrick also contributes to housing for personnel by sponsoring the construction of houses and apartments, and by purchasing mobile homes in the Elko area. To date, Barrick has underwritten the construction of approximately ___ housing units in the Elko area.

Other financial assistance to the community is provided by Barrick to help the community meet the increasing demand on services. Barrick made direct contributions of $412,000 in 1988 and more than $500,000 in 1989 to various local governmental agencies.

2.1.6 Health and Human Safety

Health and human safety issues are regulated by various agencies, both state and federal. Mining operations are regulated by the federal Mining Safety and Health Administration (MSHA), which enforces regulations about occupation hazards of surface and underground mines. Issues addressed by

MSHA regulations include noise, lighting, ventilation, heating, radiation, and exposure to hazardous materials. Barrick is in compliance with all MSHA regulations at the Goldstrike Mine. The EPA requires a Spill Prevention, Control, and Countermeasures Plan (SPCC) of all companies. The Nevada Division of Health, Department of Human Services requires an Emergency Response Plan which, in some cases, can also serve the place of an SPCC plan. An integral part of an SPCC plan is the identification of hazards (from all sources including materials on-site, facilities, vehicles, and operations), and a stated plan for preventing accidents and for responding to accidents which may happen. Barrick has an approved SPCC plan on file with state agencies and the EPA, and an approved Safety Plan on file with MSHA.

2.2 Proposed Action

2.2.1 Summary of Proposed Action

Operations at the Goldstrike Mine have involved the mining of predominantly oxide ore from the Post Deposit and other smaller ore deposits. Over the last several years, Barrick has defined a deeper, predominantly sulfide ore deposit, the Betze Deposit. The Betze Deposit is approximately 7,000 feet long and 1,880 feet wide, with thicknesses as great as 600 feet. The current ore reserve estimate indicates a combined oxide and sulfide reserve of 15.1 million contained ounces of gold. Barrick proposes an expansion of its existing gold mining operations to allow the development of the Betze Deposit. This development would necessitate the expansion of the existing Post Pit and would require an increase in the capacity of the heap leaching and milling facilities.

The expansion of mining operations would require additional waste rock disposal areas, ore stockpiles, and a continuation and expansion of existing mine dewatering facilities. The expansion of heap leaching operations would require a new heap leach pad in the central portion of the North Block, solution collection ponds, and gold recovery facilities (carbon columns) to allow leaching of approximately 36 million tons of leach ore. The existing carbon stripping, electrowinning, and refining facility, located on the AA Block, would be used to process the gold-loaded carbon from both leach facilities. The expansion of the mill facilities would require an increase of milling capacity from 6,000 tons per day (tpd)

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The expansion of mining operations would require additional waste rock disposal areas, ore stockpiles, and a continuation and expansion of existing mine dewatering facilities. The expansion of heap leaching operations would require a new heap leach pad in the central portion of the North Block, solution collection ponds, and gold recovery facilities (carbon columns) to allow leaching of approximately 36 million tons of leach ore. The existing carbon stripping, electrowinning, and refining facility, located on the AA Block, would be used to process the gold-loaded carbon from both leach facilities. The expansion of the mill facilities would require an increase of milling capacity from 6,000 tons per day (tpd)

to approximately 13,000 tpd, construction of five additional autoclaves, expansion of the oxygen plant, and construction of an additional tailings impoundment. The infrastructure at the Goldstrike Mine, including equipment fleets, ancillary facilities, and manpower, would have to be increased to accommodate the proposed expansion.

The gold mineralization in the Betze Deposit includes both oxide and sulfide ore zones. The characteristics of the two types of ore are described in Section 3.2.3. The minable reserves contained within the proposed Betze Pit are summarized below:

Oxide Ore	60.8 million tons at 0.029 oz/ton =	1.76 million oz.
Sulfide Ore	81.4 million tons at 0.159 oz/ton =	12.94 million oz.
Waste Rock	815.2 million tons	

Figure 2-5 shows the general location of the various components of the proposed action. Table 2-3 presents the acreages that would be disturbed by the proposed mining and processing activities. These components are discussed in more detail in the following subsections.

2.2.2 Proposed Mining Operations

Development of the Betze Pit would involve the progressive expansion of the Post Pit, both laterally and to depth. This development would proceed in a series of stages, as shown in Figure 2-6. Although not part of the proposed action, this EIS also considers the development of Newmont's Post Surface Deposit, because such development is functionally connected to the proposed action. Barrick is presently mining part of this deposit for Newmont under contract, and intends to continue such mining.

2.2.2.1 Drilling and Blasting. Ore would be drilled in the Betze Pit on benches 20 feet in height, using a square drilling pattern with 6.75- to 9-inch holes spaced approximately 15 to 25 feet apart. Waste rock would be drilled on benches 40 feet high, using a similar drilling pattern. Both ore and waste rock would be blasted with ammonium nitrate-fuel oil (ANFO) explosives with an average powder factor of approximately 0.4 pound of explosive per ton of rock.

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Oxide Ore 60.8 million tons at 0.029 oz/ton = 1.76 million oz.
Sulfide Ore 81.4 million tons at 0.159 oz/ton = 12.94 million oz.
Waste Rock 815.7 million tons

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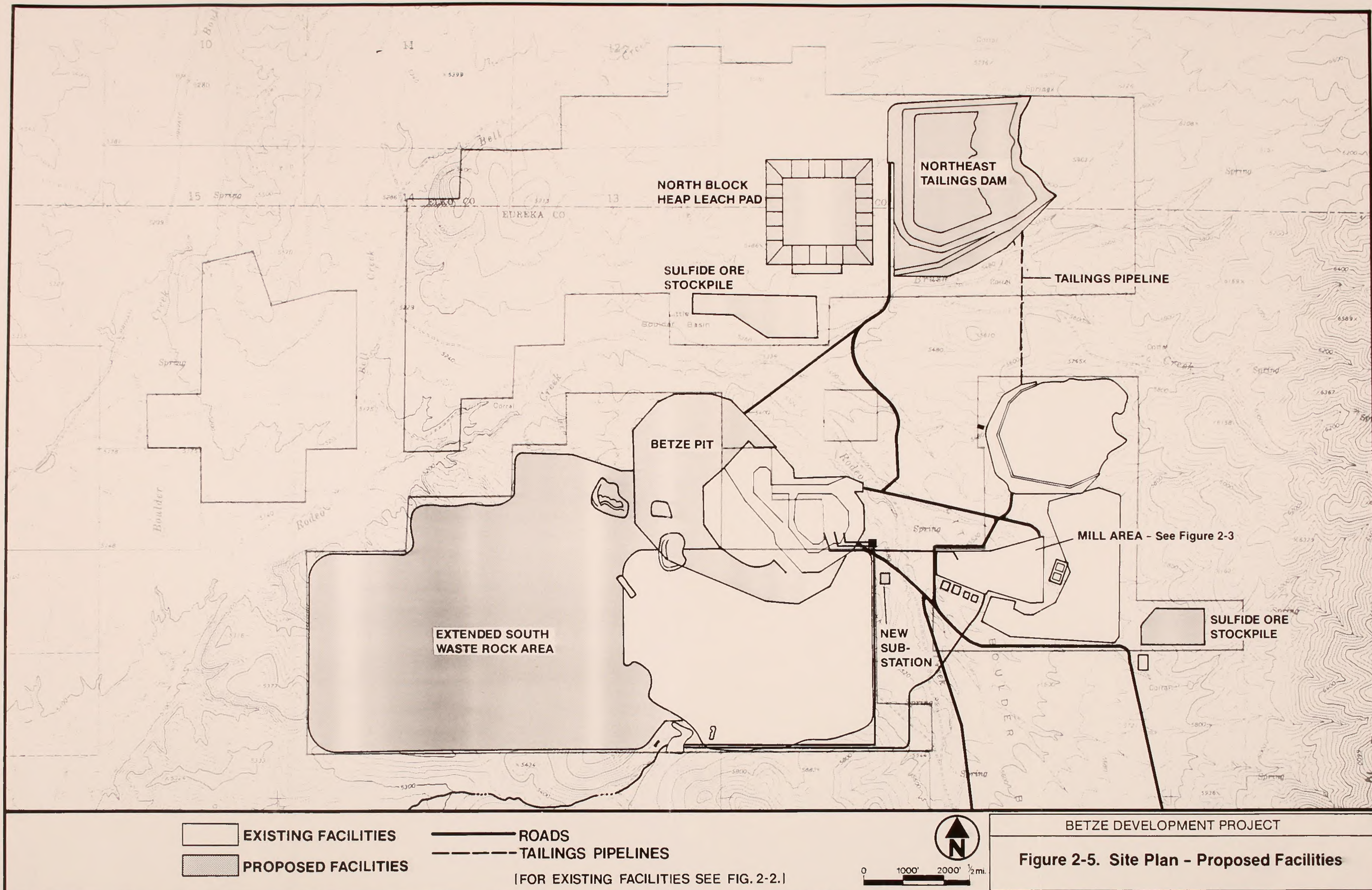


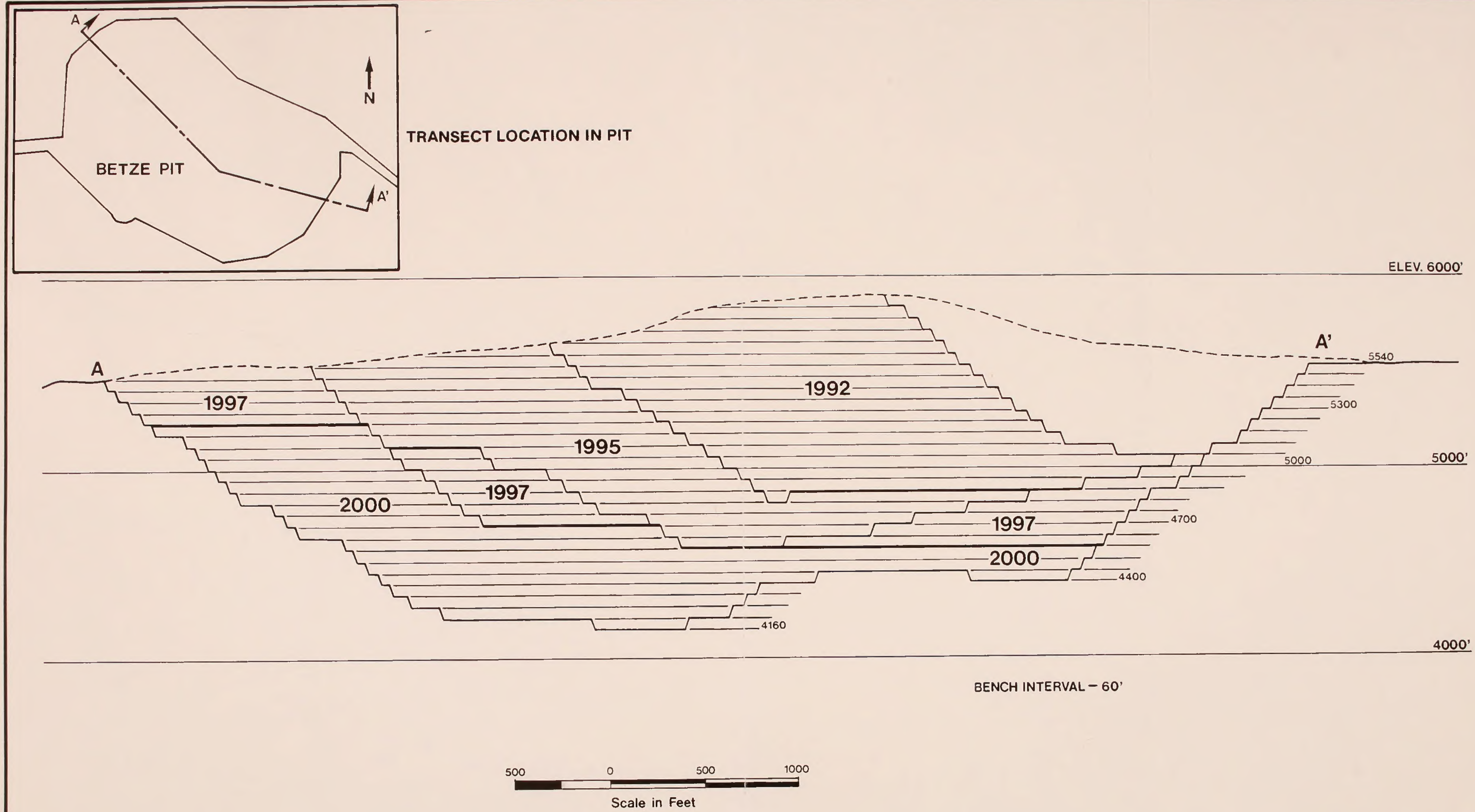
BETZE DEVELOPMENT PROJECT

Figure 2-5. Site Plan - Proposed Facilities

TABLE 2-3

ADDITIONAL DISTURBANCE BY PROPOSED FACILITIES

Facility	Acreage
Heap Leach Pad (North Block)	165
Tailings Impoundment	376
Extended South Block Waste Rock Area	1,150
Betze Pit	290
Mill Site	8.5
Sulfide Ore Stockpiles	98
Topsoil Stockpiles	82
Additional Proposed Disturbance	2,169.5



BETZE DEVELOPMENT PROJECT

Figure 2-6. Betze Pit Mine Plan

2.2.2.2 Loading and Hauling. The blasted rock would be loaded by hydraulic and electric shovels or front-end loaders into 85-ton, 100-ton, or 190-ton capacity trucks. Waste rock would be hauled to the waste rock disposal areas or to construction projects. Ore would be trucked to either the processing facilities on the AA Block or to ore stockpiles. The equipment fleet would be expanded as shown in Table 2-4. Estimated annual fuel consumption for the maximum vehicle fleet would be approximately 13 million gallons of diesel fuel and 312,000 gallons of gasoline.

To meet future dust suppression needs, three additional water trucks would supplement the two existing water trucks. Magnesium chloride or a similar dust suppressant would also continue to be applied when necessary.

Haulage ramps in the proposed Betze Pit have been designed for a minimum width of 120 feet and a gradient of 8 percent; minor sections would have grades as steep as 10 percent. Haul roads from the Betze Pit to the waste rock disposal areas, ore stockpiles, and the processing facilities would be approximately 140 feet wide including berms, shoulders, and drainage ditches.

2.2.2.3 Ore Stockpiles. After 1992, the mining operations would produce sulfide ore at a rate greater than the capacity of the processing facilities. Lower grade run-of-mine sulfide ore would be hauled to ore stockpiles for subsequent processing in the years following the completion of mining operations (after the year 2000). It is estimated that the ore stockpiles would ultimately contain 24 million tons of sulfide ore, an amount sufficient to sustain processing operations for approximately 6 years after mining of the Betze Deposit ceases.

The proposed action would require two ore stockpiles. A 60-acre ore stockpile would be located south of the proposed North Block leach pad; another 38-acre ore stockpile would be located east of the AA Block leach pads (Figure 2-5).

2.2.2.4 Waste Rock Disposal. Waste rock constitutes more than 85 percent of the material contained within the proposed Betze Pit. The greatest portion of waste rock would be hauled directly from the mine to the waste rock disposal areas; a fraction of the waste rock would be used as material for construction projects.

2.2.2.2 Loading and Hauling. The blasted rock would be loaded by hydraulic and electric shovels or front-end loaders into 85-ton, 100-ton, or 190-ton capacity trucks. Waste rock would be hauled to the waste rock disposal areas or to construction projects. Ore would be trucked to either the processing facilities on the AA Block or to ore stockpiles. The equipment fleet would be expanded as shown in Table 2-4. Estimated annual fuel consumption for the maximum vehicle fleet would be approximately 13 million gallons of diesel fuel and 252,000 gallons of gasoline.

To meet future dust suppression needs, three additional water trucks would supplement the two existing water trucks. Magnesium chloride or a similar dust suppressant would also continue to be applied when necessary.

Haulage ramps in the proposed Betze Pit have been designed for a minimum width of 120 feet and a gradient of 8 percent; minor sections would have grades as steep as 10 percent. Haul roads from the Betze Pit to the waste rock disposal areas, ore stockpiles, and the processing facilities would be approximately 140 feet wide including berms, shoulders, and drainage ditches.

2.2.2.3 Ore Stockpiles. After 1997, the mining operations would produce sulfide ore at a rate greater than the capacity of the processing facilities. Lower grade run-of-mine sulfide ore would be hauled to ore stockpiles for subsequent processing in the years following the completion of mining operations (after the year 2000). It is estimated that the ore stockpiles would ultimately contain 24 million tons of sulfide ore, an amount sufficient to sustain processing operations for approximately 6 years after mining of the Betze Deposit ceases.

The proposed action would require two ore stockpiles. A 50-acre ore stockpile would be located south of the proposed North Block leach pad; another 38-acre ore stockpile would be located east of the AA Block leach pads (Figure 2-5).

2.2.2.4 Waste Rock Disposal. Waste rock constitutes more than 85 percent of the material contained within the proposed Betze Pit. The greatest portion of waste rock would be hauled directly from the mine to the waste rock disposal areas; a fraction of the waste rock would be used as material for construction projects.

TABLE 2-4

PROPOSED MINE EQUIPMENT

Equipment Type		Number
Shovels	Hydraulic - 13.5 cubic yard	3
	Hydraulic - 23.5 cubic yard	3
	Electric - 40 cubic yard	2
Haul Trucks	85 ton	18[1]
	100 ton	12
	190 ton	40
Front End Loaders	FEL - 13.5 cubic yard	4
Blast Hole Drills	40,000 lb rating	4
	60,000 lb rating	4
	Long Hole Rig	1
Rubber-Tired Dozer	35 ton	0
	51 ton	7
Tracked Dozers	37 ton	3
	62 ton	7
Road Graders	14 G and 16 G classes	6
Water Trucks	11,000 gallon capacity	2
	16,000 gallon capacity	3
Scrapers	30 cubic yard	4
Backhoes	6 cubic yard	2
Crane	40 ton	2
	150 ton	1

[1] The 85-ton trucks eventually will be retired.

The proposed action would require an Extended South Block waste rock disposal area, including extension of the existing waste rock disposal area to the west to achieve full utilization of the South Block area while remaining within Barrick's property boundaries. The proposed action would also require continued disposal on the existing South waste rock disposal area. The proposed annual schedule of waste rock disposal deliveries is shown in Table 2-5.

The South waste rock disposal area is currently being used for the disposal of waste rock from the Post Pit. Approximately 259.3 million tons more of Betze Pit waste rock would be placed in this waste rock disposal area.

The proposed Extended South waste rock disposal area, south and southwest of the Betze Pit, has been designed to contain approximately 815.2 million tons of additional waste rock to an elevation of 5,900 to 6,000 feet. The height of the Extended South waste rock disposal area would be approximately 700 feet above the original ground elevation on its north and west boundaries and approximately 500 feet on its south and east boundaries. It would be approximately 1,430 acres in size.

Access to the Extended South waste rock disposal area would be located at the southeast and northwest margins of the Betze Pit. The maximum haul distance would be approximately 1.9 miles one way.

The waste rock disposal area would be constructed by dumping laterally in vertical lifts approximately 100 feet high. Each succeeding lift would be made smaller than the preceding lift to create a terraced effect. The terrace would help control runoff and erosion, provide for slope stability, and facilitate reclamation. The slope of each lift would be modified during reclamation from the natural angle of repose to an internal slope angle of approximately 2.3H:1V, which would allow topsoil placement and operation of reclamation equipment. The final overall dump slope would be approximately 2.5H:1V. Reclamation measures are described in more detail in Section 2.2.4.

2.2.2.5 Mining Schedule. The proposed mine production schedule is shown in Table 2-6. Mine development has been designed by Barrick to provide early access to higher grade sections of the Betze Deposit and to provide reasonable consistency in the total tonnages to be mined from year to year. Under the proposed plan, the Betze Deposit would be mined to

The proposed action would require an Extended South Block waste rock disposal area, including extension of the existing waste rock disposal area to the west to achieve full utilization of the South Block area while remaining within Barrick's property boundaries. The proposed action would also require continued disposal on the existing South waste rock disposal area. The proposed annual schedule of waste rock disposal deliveries is shown in Table 2-5.

The South waste rock disposal area is currently being used for the disposal of waste rock from the Post Pit. Approximately 289.3 million tons more of Betze Pit waste rock would be placed in this waste rock disposal area.

The proposed Extended South waste rock disposal area, south and southeast of the Betze Pit, has been designed to contain approximately 815.2 million tons of additional waste rock to an elevation of 5,900 to 6,000 feet. The height of the Extended South waste rock disposal area would be approximately 700 feet above the original ground elevation on its north and west boundaries and approximately 500 feet on its south and east boundaries. It would be approximately 1,420 acres in size.

Access to the Extended South waste rock disposal area would be located at the southeast and southwest margins of the Betze Pit. The maximum haul distance would be approximately 1.9 miles one way.

The waste rock disposal area would be constructed by dumping laterally in vertical lifts approximately 100 feet high. Each succeeding lift would be made smaller than the preceding lift to create a terraced effect. The terrace would help control runoff and erosion, provide for slope stability, and facilitate reclamation. The slope of each lift would be modified during reclamation from the natural angle of repose to an interval slope angle of approximately 2.5H:1V, which would allow topsoil placement and operation of reclamation equipment. The final overall dump slope would be approximately 2.5H:1V. Reclamation measures are described in more detail in Section 2.2.4.

2.2.2.3 Mining Schedule. The proposed mine production schedule is shown in Table 2-6. Mine development has been designed by Barrick to provide early access to higher grade sections of the Betze Deposit and to provide reasonable consistency in the total tonnages to be mined from year to year. Under the proposed plan, the Betze Deposit would be mined to

TABLE 2-5

ANNUAL SCHEDULE OF WASTE ROCK DELIVERIES

(MILLION TONS)

Year	South Waste Rock Disposal Area[1]	West Waste Rock Disposal Area[1]	Total
1990	55.2	--	55.2
1991	101.4	--	101.4
1992	71.2	25.9	97.1
1993	--	75.6	75.6
1994	20.6	69.5	90.1
1995	10.9	74.4	85.3
1996	--	62.7	62.7
1997	--	95.8	95.8
1998	--	98.6	98.6
1999	--	43.2	43.2
2000	--	10.2	10.2
TOTAL	259.3	555.9	815.2

[1] The South Waste Rock Disposal Area has some existing waste rock storage. The South and West Waste Rock Disposal Areas together comprise the Extended South Waste Rock Disposal Area which would contain all waste rock from the Betze Pit.

TABLE 2-6

MINE PRODUCTION SCHEDULE

1990 - 2000

Year	Oxide Ore	Refrac. Ore	Waste Rock	Total	Waste to Ore Ratio
	Million Tons				
1990[1]	5.69	0.32	55.24	61.25	9.20
1991	20.29	1.04	101.36	122.69	4.75
1992	14.87	3.07	97.12	115.06	5.42
1993	5.05	3.92	75.55	84.52	8.43
1994	5.31	4.75	90.14	100.21	8.96
1995	4.25	4.57	85.25	94.07	9.67
1996	0.88	7.77	62.71	71.35	7.25
1997	0.97	4.26	95.78	101.01	18.33
1998	1.91	2.91	98.60	103.42	20.45
1999	1.55	32.51	43.22	77.27	1.27
2000	0 [2]	16.29	10.16	26.45	0.62
TOTAL	60.76	81.39	815.15	957.30	5.73

[1] July through December 1990.

[2] Minor quantities of oxide ore may be mined in the year 2000.

completion in the year 2000. The plan would allow continuation of the existing daily production rate from open-pit operations of approximately 325,000 tons of ore and waste rock per day. Initially, the bulk of the ore would be produced from oxide ore zones. Approximately 80 percent of the oxide ore reserve would be mined prior to 1993. Thereafter, operations would progress into the underlying sulfide ore zones, and relatively small quantities of oxide ore would be produced during the remaining life of the Betze Pit. Production of sulfide ore would increase to almost 3.1 million tons in 1992.

As shown in Table 2-6, during the later stages of mining in the Betze Pit the production rate would diminish because of the increased haulage distances to the waste rock disposal areas. Maximum mine production would occur during the period from 1991 through 1994, during which time the annual production of ore and waste rock would be approximately 115 million tons per year (tpy). Maximum sulfide ore production, 32.5 million tpy, is expected in the year 1999, the next to last year of mining. At the conclusion of mining of the Betze Deposit, the pit would reach a depth of approximately 1,300 to 1,500 feet below the surrounding terrain. The pit walls would have an approximate overall slope angle of 38 degrees. As noted in subsection 2.2.2.3, processing would continue for another 6 years after mining of the Betze Deposit is complete.

The average stripping ratio for the proposed Betze Pit is 5.7 tons of waste per ton of ore. The overall waste ratio is influenced by the large tonnages of lower-grade oxide ore within the expanded pit.

2.2.2.6 Mine Dewatering. Mining of the Betze Pit would require the continuation and expansion of the dewatering operations in the Post Pit. During the 12 years of development, average inflow to the Betze Pit is estimated to be approximately 23,952 gallons per minute (gpm). Inflow estimates have been based on modeling criteria reflecting the existence of hydrologic boundaries. The pumping rates would vary as the Betze Pit becomes progressively deeper. Pumping would be required to keep water levels below the elevation of the working pit floor to allow continuation of mining. The following is an estimate of groundwater pumping rates by year (Leggette, Brashears & Graham, Inc. 1990):

completion in the year 2000. The plan would allow continuation of the existing daily production rate from open-pit operations of approximately 325,000 tons of ore and waste rock per day. Initially, the bulk of the ore would be produced from oxide ore zones. Approximately 65 percent of the oxide ore reserve would be mined prior to 1993. Thereafter, operations would progress into the underlying sulfide ore zones, and relatively small quantities of oxide ore would be produced during the remaining life of the Betze Pit. Production of sulfide ore would increase to almost 8.1 million tons in 1997.

As shown in Table 2-6, during the later stages of mining in the Betze Pit the production rate would diminish because of the increased haulage distances to the waste rock disposal areas. Maximum mine production would occur during the period from 1991 through 1994, during which time the annual production of ore and waste rock would be approximately 115 million tons per year (tpy). Maximum sulfide ore production, 12.5 million tpy, is expected in the year 1999, the next to last year of mining. At the conclusion of mining of the Betze Deposit, the pit would reach a depth of approximately 1,300 to 1,500 feet below the surrounding terrain. The pit walls would have an approximate overall slope angle of 38 degrees. As noted in subsection 2.2.4.3, processing would continue for another 6 years after mining of the Betze Deposit is complete.

The average stripping ratio for the proposed Betze Pit is 5.7 tons of waste per ton of ore. The overall waste ratio is influenced by the large tonnage of lower-grade oxide ore within the expanded pit.

2.2.4.6 Mine Dewatering. Mining of the Betze Pit would require the continuation and expansion of the dewatering operations in the Post Pit. During the 12 years of development, average inflow to the Betze Pit is estimated to be approximately 23,572 gallons per minute (gpm). Inflow estimates have been based on modeling criteria reflecting the existence of hydrologic boundaries. The pumping rates would vary as the Betze Pit becomes progressively deeper. Pumping would be required to keep water levels below the elevation of the working pit floor to allow continuation of mining. The following is an estimate of groundwater pumping rates by year (Leggette, Brashears & Graham, Inc. 1990):

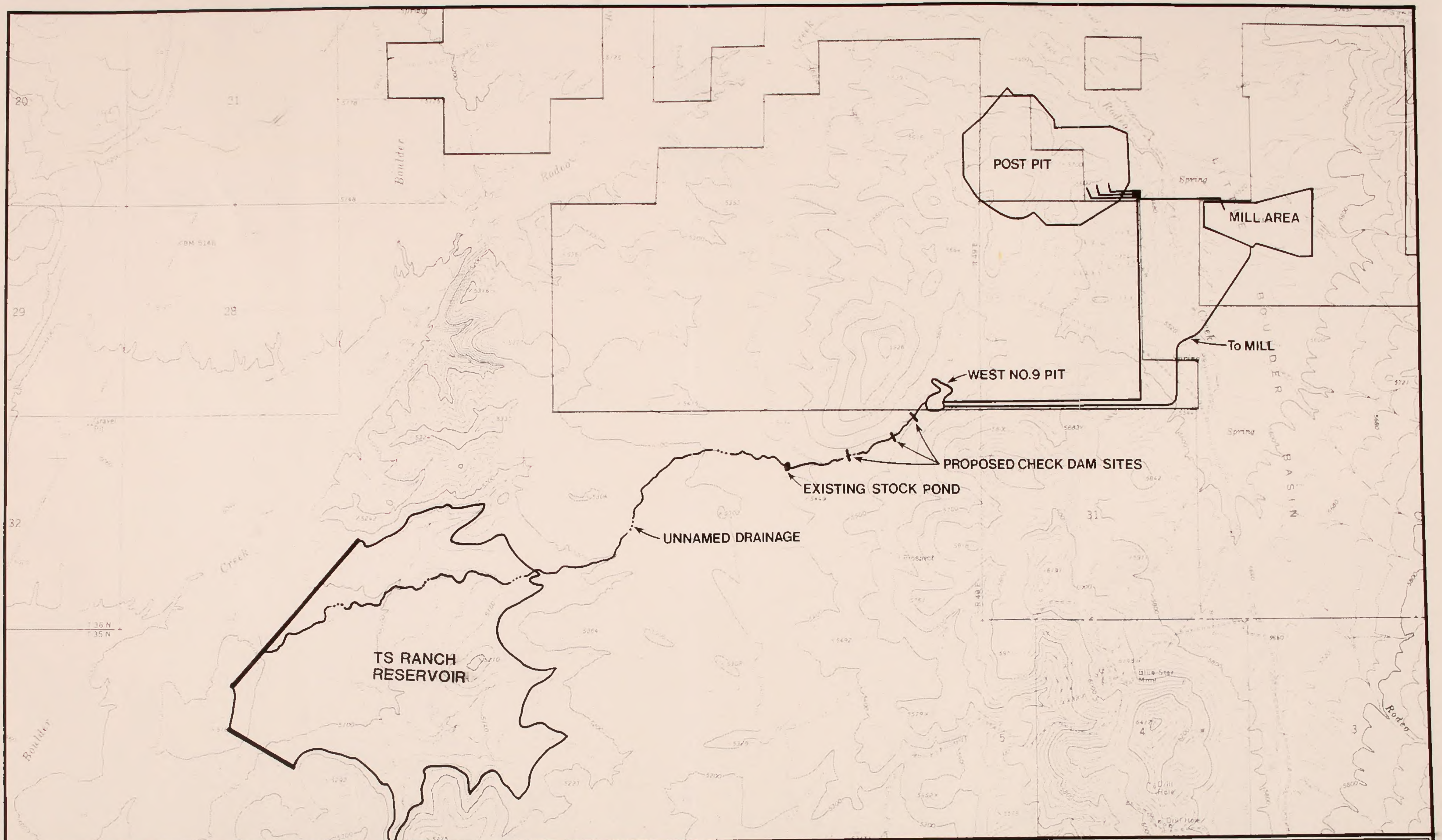
Year	Average Pumping Rate (GPM)
1990	12,060
1991	18,591
1992	12,289
1993	10,407
1994	12,271
1995	18,906
1996	14,315
1997	12,846
1998	17,706
1999	17,437
2000	29,330

The Betze Pit would be dewatered by using wells and in-pit sumps to intercept the projected inflow. A component of the inflow is likely to arise from upward vertical flow toward the pit bottom (Barrick 1988b). Some of the dewatering wells are expected to be drilled within the Betze Pit. The majority of the existing wells used for dewatering the Post Pit are in-pit wells. It is estimated that a total of 30 to 40 wells, both in-pit and perimeter, would have to be drilled and placed into use by the year 2000.

Horizontal drain holes, as needed, would be drilled in pit walls. The drain holes would be used to supplement the dewatering wells and to improve pit wall stability. A piezometer network would be constructed in the Betze Pit to monitor the drainage of the various in-pit hydrogeologic sectors and to determine where additional horizontal drain holes were necessary.

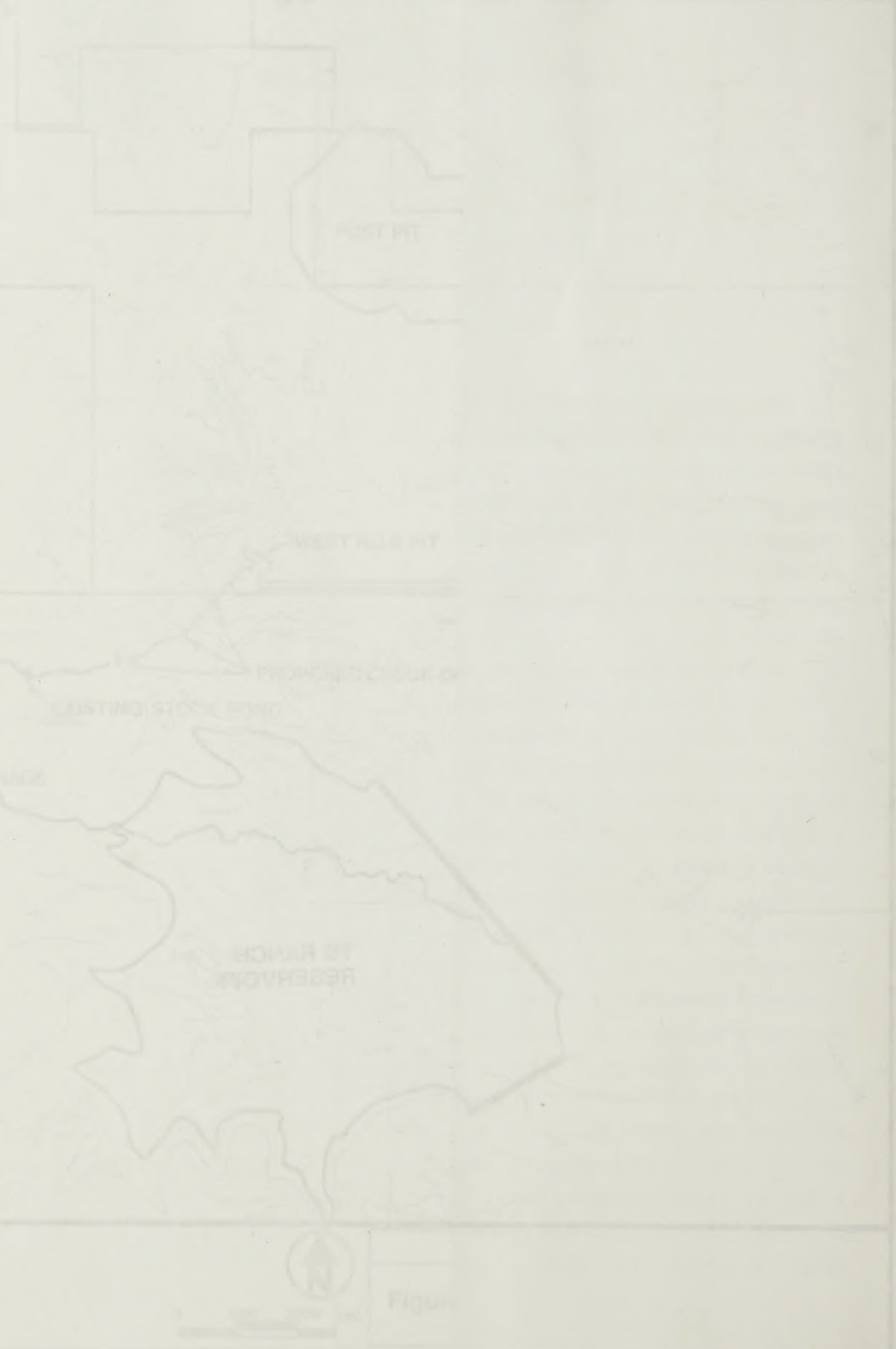
Water produced from the wells would be piped to booster pump stations located outside of the active mine area or directly to the West No. 9 Pit. The booster pump stations would pump the water to either the mill and leach operations or to the existing holding area, the West No. 9 Pit (Figure 2-7). Water collected in the in-pit sumps would be pumped from floating barges on the sumps. The sumps would be located as needed on pit benches and in the pit bottom. The water from the sumps would also be pumped to the West No. 9 Pit.

Barrick has constructed a water treatment facility at West No. 9 Pit to treat the Betze Pit water with ferric sulfate for arsenic and heavy metals. The facility consists of surge tanks and mixing and precipitation tanks to treat incoming water prior to its discharge to the unnamed drainage. Arsenic concentrations are lowered to levels below the drinking water standard. Flocculant is added to the treated stream to aid in the



BETZE DEVELOPMENT PROJECT

Figure 2-7. Mine Dewatering Arrangement Map


EXISTING STOCK POND

settling of the precipitate in the lined settling pond. The facility, which currently has a capacity to treat 10,000 gpm of mine water, will be expanded to handle 20,000 gpm of mine water prior to discharge down the unnamed drainage.

Explain

EP toxicity and TC testing have determined that the precipitate generated during the water treatment is not a characteristic hazardous waste. The precipitate will be removed from the settling ponds on a regular basis and deposited inside the tailings impoundment.

It is anticipated that approximately 3,500 to 4,500 gpm of dewatering water would be used for mining and milling purposes, including process system makeup, mine operations, dust control, exploration drilling, construction, and, with approved treatment, potable consumption.

Water from dewatering operations not used to satisfy mining and milling needs would be treated to reduce the arsenic concentrations, as necessary, and would be discharged via the unnamed drainage to the TS Ranch Reservoir. The water stored in the TS Ranch Reservoir would be used for irrigation purposes or would be discharged and would ultimately flow into Boulder Creek. The unnamed drainage would be monitored for any indications of erosion, and the existing sediment control dams would be appropriately maintained. Additional structures would be built to control channel erosion if necessary.

Water Monitoring Plan. Surface and groundwater are currently being monitored via the Boulder Valley Monitoring Plan conducted by Barrick, Newmont Gold, and the TS Ranch. The monitoring plan is a requirement by the State Engineer as a condition of the numerous water rights held by the three entities. Surface water flow and quality are monitored monthly in Rodeo, Brush, Bell, and Boulder Creeks at a total of 12 sites. There is at least one continuous flow monitor on each of these creeks except Bell. Groundwater quality and depth are monitored by Barrick, around the Post Pit, and by Newmont, around the Genesis Pit, at a total of 41 sites.

2.2.3 Proposed Processing Facilities

The proposed expansion of mining operations to allow the recovery of the gold contained in the Betze Deposit would require the expansion of heap leaching operations, the expansion of milling facilities, construction of

settling of the precipitates in the lined settling pond. The facility, which currently has a capacity to treat 10,000 gpm of mine water, will be expanded to handle 20,000 gpm of mine water prior to discharge down the unnamed drainage.

Toxicity characteristic testing have determined that the precipitate generated during the water treatment is not a characteristic hazardous waste. . The precipitate will be removed from the settling ponds on a regular basis and deposited inside the tailings impoundment.

It is anticipated that approximately 3,500 to 4,500 gpm of dewatering water would be used for mining and milling purposes, including process system makeup, mine operations, dust control, exploration drilling, construction, and, with approved treatment, potable consumption.

Water from dewatering operations not used to satisfy mining and milling needs would be treated to reduce the arsenic concentrations, as necessary, and would be discharged via the unnamed drainage to the TS Ranch Reservoir. The water stored in the TS Ranch Reservoir would be used for irrigation purposes or would be discharged and would ultimately flow into Boulder Creek. The unnamed drainage would be monitored for any indications of erosion, and the existing sediment control dams would be appropriately maintained. Additional structures would be built to control channel erosion if necessary.

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2.2.3 Proposed Processing Facilities

The proposed expansion of mining operations to allow the recovery of the gold contained in the Betze Deposit would require the expansion of heap leaching operations, the expansion of milling facilities, construction of

five additional autoclaves, a corresponding increase in oxygen plant capacity, and construction of an additional tailings impoundment.

2.2.3.1 Heap Leaching Expansion. Mining of the Post Pit and the proposed Betze Pit would generate approximately 61 million tons of oxide leach ore. The existing and future leaching facilities already permitted in the AA Block will be capable of processing approximately 42 percent of this ore. Additional heap leaching operations would be required to allow processing of approximately 35 million tons of leach ore.

The proposed action is to expand heap leaching operations by constructing heap leach pads, solution collection ponds, a gold recovery facility (carbon columns), and associated infrastructure in the central portion of the North Block (see Figure 2-5). The proposed facilities would be located west of the proposed North Block tailings impoundment and would disturb approximately 165 acres.

Leach grade ore would be hauled from the existing crushing and agglomeration circuit located on the AA Block or as run-of-mine ore from the Betze Pit.

The leach ore would be placed on an 80-mil synthetic liner overlaying the native soils. Geological investigations (Barrick 1989a) of the proposed heap leaching facilities site indicate that the near-surface soils are similar to those which underlie the heap leaching facilities on the AA Block. Silts and clays of the Carlin Formation cover the proposed area. Because of the impermeable sediments and depth to groundwater, a secondary liner is not proposed for use underneath the primary synthetic liner.

The solution collection ponds would have a primary 80-mil synthetic liner underlain by a secondary clay liner, as required by Nevada Division of Environmental Protection regulations. A leak detection/collection system will be incorporated into the design of the system.

A dilute cyanide solution would be applied to the leach ore on the pads and would percolate through the heap to the synthetic liner, extracting the gold. The pregnant solution would be collected in the pregnant solution collection pond and would be pumped to the carbon columns in the gold recovery facility. The gold in the solution would be adsorbed onto the activated carbon in the carbon columns, leaving a barren solution. The barren solution would be stored in a barren solution collection pond. The barren solution would be recirculated to the heaps after cyanide and

caustic makeup is added to maintain adequate cyanide concentration and pH control. The gold-loaded carbon would be trucked to the existing facility on the AA Block for carbon stripping, electrowinning, and refining.

2.2.3.2 Mill Facilities Expansion. The existing mill treats 6,000 tons of oxide ore and 1,500 tons of sulfide ore per day. Barrick proposes to expand the pressure oxidation circuit to treat 6,000 tons of sulfide ore per day by the end of 1991 and to expand the milling and pressure oxidation capacity to treat approximately 13,000 tons of sulfide ore per day by the end of 1992.

To treat 6,000 tons of sulfide ore per day by 1991, Barrick must add certain facilities to the existing mill. Barrick proposes to construct two additional autoclaves, each rated at 2,250 tpd, a new carbon reactivation system, and an eighth tank in the CIL circuit. After the conversion of the mill to a 6,000 tpd sulfide ore circuit, oxide ore would still be batch processed through the mill as needed.

The expansion from 6,000 to approximately 13,000 tons of sulfide ore per day would require the following additional equipment:

- One SAG mill
- One short head cone crusher
- One large ball mill
- Eight cyclones
- Three additional autoclaves
- Six CIL tanks
- Two pressure stripping vessels
- Four electrowinning cells
- One induction furnace

Sites selected for the construction of the new mill facilities would be restricted to the areas directly adjacent to the existing facilities to take advantage of existing power and water supplies and to eliminate the need for extended infrastructure such as pipelines, powerlines, and roads, although a new powerline and substation would be needed. In some instances, expansion would consist of direct additions to existing structures. Figure 2-3 shows the location and arrangement of the existing and proposed milling facilities. A more detailed description of each major component is set forth below.

Crushing. The crushing circuit would not be expanded. The existing jaw crusher is undersized for 13,000 tons per day. However, capacity would

be available because the existing gyratory crusher would be integrated into the milling circuit. This would allow one crusher to supplement the other or replace it during periods of maintenance or repair. A second coarse ore stockpile, with a live capacity of 7,500 tons, also would be required.

Milling. An additional milling circuit would be required to grind the incremental 7,000 tpd of sulfide ore. This circuit would consist of a SAG mill, short head cone crusher to crush oversize material from the SAG mill discharge, ball mill, and eight additional cyclones.

Pressure Oxidation Circuit. To process 13,000 tpd of sulfide ore, a total of six pressure oxidation circuits would be required. One circuit, rated at 1,500 tons of ore per day, is part of the existing mill; two additional circuits, each rated at 2,250 tpd, would be installed in 1991 to raise the total capacity to 6,000 tpd of sulfide ore. Three similar circuits would be added in 1992 to reach the design capacity of 13,000 tons per day.

The oxide mill would continue to process oxide ore until the end of 1991, by which time it would be fully converted to treat sulfide ore. Ore would be fed directly from the mine to the mill until mining operations cease in the year 2000. Thereafter, feed for the mill would be drawn from the sulfide ore stockpiles until 2006.

The sulfide ore from the grinding circuit would be thickened prior to acidulation with sulfuric acid. The acidulation would convert the carbonates in the sulfide ore slurry to carbon dioxide to reduce such formation within the autoclave and reduce venting requirements. Following acidulation, the sulfide ore slurry would be pumped into the pressure oxidation circuits.

Each pressure oxidation circuit would consist of a series of three splash steam condensers, where incoming slurry would be pre-heated; a horizontal autoclave vessel in which the oxidation would take place; and three slurry flash tanks and slurry heat exchanger where the exiting slurry temperature and pressure would be lowered back to atmospheric conditions.

Oxygen required for the pressure oxidation process would be produced in a cryogenic air separation plant located near the autoclave installation. The existing oxygen plant produces 175 tpd of oxygen. The

be available because the existing gyratory crusher would be integrated into the milling circuit. This would allow one crusher to supplement the other or replace it during periods of maintenance or repair. A second coarse ore stockpile, with a live capacity of 7,500 tons, also would be required.

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The sulfide ore from the grinding circuit would be thickened prior to acidulation with sulfuric acid. The acidulation would convert the carbonates in the sulfide ore slurry to carbon dioxide to reduce scale formation within the autoclave and reduce venting requirements. Following acidulation, the sulfide ore slurry would be pumped into the pressure oxidation circuits.

Each pressure oxidation circuit would consist of a series of three splash steam condensers, where incoming slurry would be pre-heated; a horizontal autoclave vessel in which the oxidation would take place; and three slurry flash tanks and slurry heat exchanger where the exiting slurry temperature and pressure would be lowered back to atmospheric conditions.

Oxygen required for the pressure oxidation process would be produced in a cryogenic air separation plant located near the autoclave installation. The existing oxygen plant produces 175 tpd of oxygen. The

plant would be expanded in two increments of 750 tpd each, to provide an ultimate oxygen capacity of 1,675 tpd. Liquid-oxygen storage tanks and vaporizers would be provided in order to supply the autoclaves with oxygen when the oxygen plant is not operating.

Lime for neutralization would be pneumatically conveyed into six lime storage tanks, each with a capacity of 250 tons. Lime slurry would be produced in six continuous lime slakers. The slaked lime would be stored in four 25-foot diameter by 25-foot high storage tanks.

Sulfuric acid for acidulation of the slurry would be received by truck and unloaded into one of two 20-foot diameter by 20-foot high carbon steel storage tanks. The sulfuric acid tanks would be surrounded by a spill containment system having a capacity in excess of the volume of one tank. Table 2-7 shows estimated reagent usage for the proposed facility expansion.

Process steam would be required to raise the temperature of the autoclaves during start-up or to provide slurry heating during operations. The largest process steam requirement would occur during periods when the sulfide sulfur content of the ore drops below 1.5 percent. Three propane-fired steam boilers, one rated at 40,000 pounds per hour and two rated at 100,000 pounds per hour each, have been incorporated into the plant design.

CIL Circuit. Six 40-foot diameter CIL tanks would be added to the existing CIL circuit in order to treat 13,000 tpd of ore. Slurry would be pumped from the pressure oxidation circuit to both the existing and proposed CIL circuits, which would be operated in parallel. This proposed circuit would be operated in a manner identical to the existing circuit. Tailings from both CIL circuits would recombine in an enlarged tailings pumpbox prior to being pumped to the tailings impoundment.

Carbon Stripping. Two 10-ton capacity carbon stripping vessels are proposed to be added to the existing circuit. These vessels would be operated in an identical manner to the existing strip circuit. Additional capacity is required due to the increased mill throughput and anticipated higher grade sulfide ore.

plant would be expanded in two increments of 750 tpd each, to provide an ultimate oxygen capacity of 1,675 tpd. Liquid-oxygen storage tanks and vaporizers would be provided in order to supply the autoclaves with oxygen when the oxygen plant is not operating.

Lime for neutralization would be pneumatically conveyed into six lime storage tanks, each with a capacity of 250 tons. Lime slurry would be produced in six continuous lime slakers. The slaked lime would be stored in four 25-foot diameter by 25-foot high storage tanks.

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CIL circuit. Six 40-foot diameter CIL tanks would be added to the existing CIL circuit in order to treat 13,000 tpd of ore. Slurry would be pumped from the pressure oxidation circuit to both the existing and proposed CIL circuits, which would be operated in parallel. This proposed circuit would be operated in a manner identical to the existing circuit. Tailings from both CIL circuits would recombine in an enlarged tailings pumpbox prior to being pumped to the tailings impoundment.

Carbon Stripping. Two 10-ton capacity carbon stripping vessels are proposed to be added to the existing circuit. These vessels would be operated in an identical manner to the existing strip circuit. Additional capacity is required due to the increased mill throughput and anticipated higher grade sulfide ore.

TABLE 2-7

ESTIMATED REAGENT USAGE

	1989	1990	1991	1992	1993-2006
Estimated High Level Consumption (tons)					
Lime	2,868	18,559	20,220	74,208	149,172
Sulfuric Acid	172	14,004	15,468	61,884	131,508
Oxygen	594	45,722	53,460	--	--
Propane	65	5,257	5,808	23,220	49,344
Cyanide	896	1,258	1,296	2,952	3,444
Estimated Low Level Consumption (tons)					
Lime	1,290	7,328	7,968	28,824	57,372
Sulfuric Acid	60	4,889	5,400	21,600	45,900
Oxygen	594	45,722	53,460	--	--
Propane	36	2,933	3,240	12,960	27,540
Cyanide	896	1,258	1,296	2,952	3,444

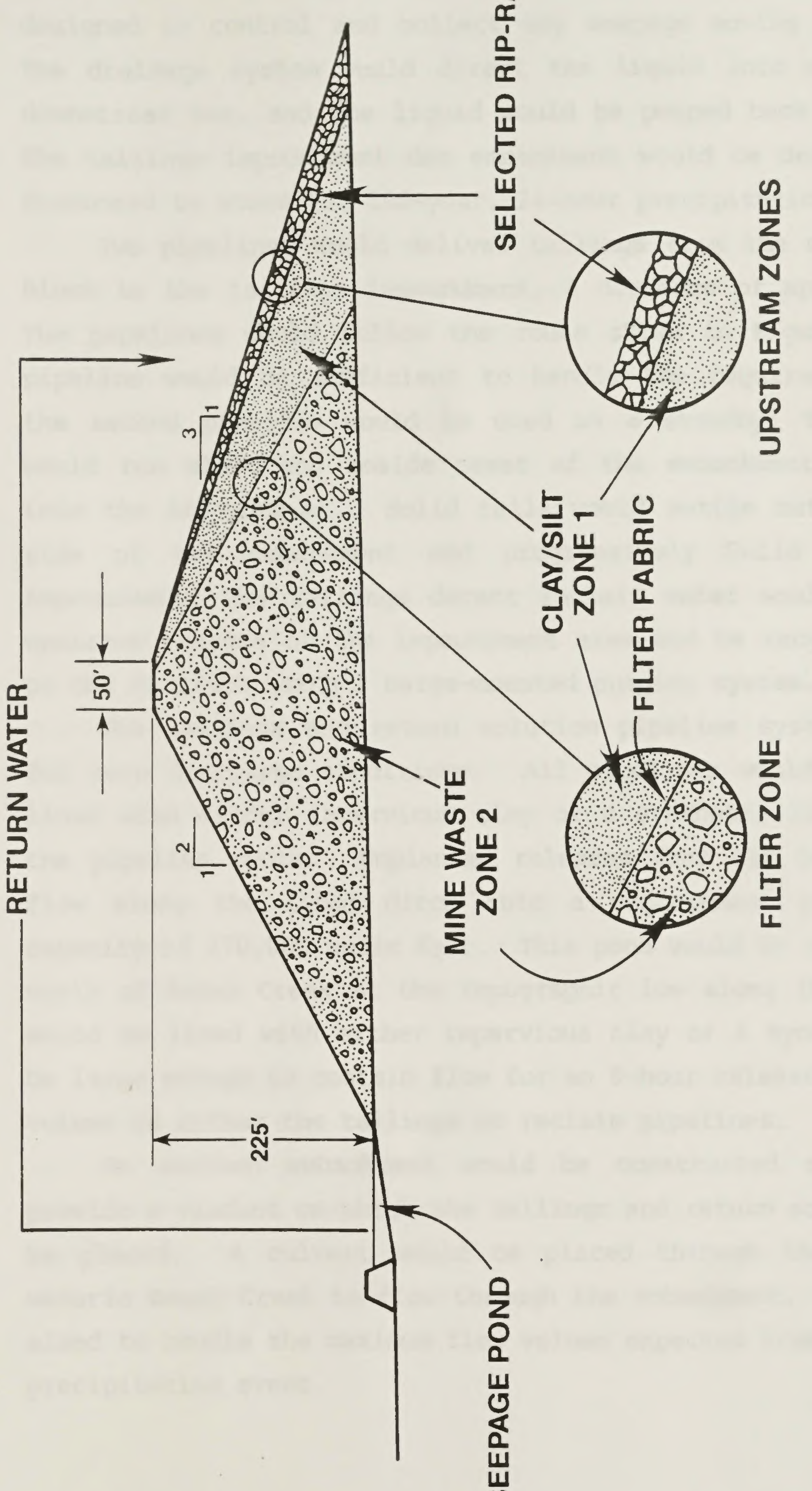
Electrowinning. Higher grade sulfide ore and increased mill throughput would require the addition of four 125-cubic foot capacity electrowinning cells and a 1000-pound capacity induction furnace. This equipment would be added to the facilities in the existing refinery.

2.2.3.3 Tailings Impoundment. Construction of a second tailings impoundment would be necessary to contain the additional tailings generated by processing the Betze ore. The site proposed for the second impoundment is on the North Block, east of the proposed North Block leach pad area (Figure 2-5). The proposed North Block tailings impoundment is located on a gentle west-dipping slope. The slope gradient is approximately 5 percent near the western end and approximately 16 percent at the eastern end at the 5,725-foot elevation, which is the planned crest elevation of the impoundment. The southern extent of the proposed tailings impoundment dam would be approximately 250 feet north of Brush Creek. At the planned crest elevation of 5,725 feet, the dam height at the topographic low point under the embankment would be approximately 225 feet. The area affected by the proposed North Block tailings impoundment would be approximately 375 acres. The embankment centerline length is approximately 1.8 miles.

Geological investigations (Barrick 1989a) of the proposed tailings impoundment site indicate that the near-surface strata are similar to those which underlie the tailings impoundment on the AA Block. Silts and clays of the Carlin Formation cover most of the area. These Carlin Formation materials thin toward the east where they form a contact at the surface with the bedded siltstones and mudstones of the Rodeo Creek Formation. Because of the combination of impermeable sediments and the depth to groundwater, a synthetic liner is not proposed.

The proposed tailings impoundment would be designed for the permanent storage of the mill tailings following closure. The final design for the tailings impoundment would be determined after consultation with the Nevada Division of Environmental Protection and the Nevada State Engineer-Dam Safety Division.

The preliminary design for the proposed North Block tailings impoundment dam, shown in Figure 2-8, is the same design as the existing AA Block tailings impoundment dam. The dam would be constructed using mine waste and native materials from the impoundment area. The downstream slope would be 2H:IV, and the upstream slope would be 3H:lV. The upstream face of



BETZE DEVELOPMENT PROJECT

Figure 2-8. Tailings Dam Section

the dam would be protected with rip-rap. The tailings dam would be designed to control and collect any seepage moving through the dam face. The drainage system would direct the liquid into a pond located at the downstream toe, and the liquid would be pumped back into the impoundment. The tailings impoundment dam embankment would be designed with sufficient freeboard to store the 100-year, 24-hour precipitation event.

Two pipelines would deliver tailings from the mill located on the AA Block to the tailings impoundment, a distance of approximately 1.7 miles. The pipelines would follow the route shown in Figure 2-5. One tailings pipeline would be sufficient to handle the required volume of tailings; the second pipeline would be used as a standby. The tailings pipelines would run along the inside crest of the embankment and discharge slurry into the impoundment. Solid tails would settle out against the upstream side of the embankment and progressively build a beach within the impoundment. The tailings decant reclaim water would form a pool in the upstream reaches of the impoundment area and be recycled back to the mill on the AA Block using a barge-mounted pumping system.

The tailings and return solution pipeline systems would be designed for zero discharge conditions. All pipelines would be placed in a ditch lined with either impervious clay or a synthetic liner for the length of the pipeline route. Unplanned releases from the tailings pipeline would flow along the lined ditch into a containment pond having a storage capacity of 270,000 cubic feet. This pond would be constructed immediately north of Brush Creek at the topographic low along the pipeline route. It would be lined with either impervious clay or a synthetic liner and would be large enough to contain flow for an 8-hour release event plus the entire volume in either the tailings or reclaim pipelines.

An earthen embankment would be constructed across Brush Creek to provide a viaduct on which the tailings and return solution pipelines would be placed. A culvert would be placed through the embankment to allow waterin Brush Creek to flow through the embankment. This culvert would be sized to handle the maximum flow volume expected from the 100-year, 24-hour precipitation event.

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An earthen embankment would be constructed across Brush Creek to provide a viaduct on which the tailings and return solution pipelines would be placed. A culvert would be placed through the embankment to allow water in Brush Creek to flow through the embankment. This culvert would be sized to handle the maximum flow volume expected from the 100-year, 24-hour precipitation event.

2.2.4 Work Force and Ancillary Facilities

2.2.4.1 Work Force. As of the Second Quarter 1990, the work force at the Goldstrike property was 1,030 employees. To meet the Betze Project expansion labor requirements, the number of operations employees would increase to a maximum of _____ in 1992. The work force necessary for the Betze Project would decrease during the years 1993 to 1999 to approximately 900 employees. After mining ends in 2000, the number of employees necessary for the Betze Project would be reduced to about 240. This workforce would continue to process ore from the stockpiles until 2006. After 2006, only a reclamation crew would continue to work on site on this project. Table 2-8 shows projected changes in the work force for the Betze Project to the year 2006.

As of the Second Quarter 1990, _____ contractor employees were on site to handle satellite mining operations and minor construction projects. This number would range from 60 per month to a peak of 310 in the summer months 1991 during the mill expansion and construction of the additional autoclaves. In 1992, construction employees would range from 20 to 150 per month. The construction personnel would decrease sharply after the major construction projects are completed by the end of 1992.

2.2.4.2 Ancillary Facilities. Existing ancillary facilities were described in Section 2.1.5. Additional expansions would be necessary for the proposed Betze Project operations, as described below.

Mine Maintenance Building. The mine maintenance building has been expanded, under previous approvals, to accommodate all planned increases in the mobile equipment fleet. The expansion involved the addition of truck bays on the east side of the existing building, specifically for the maintenance of 190-ton haul trucks, and additional lubrication facilities. A 35-ton crane would be installed to service the new bays, but no other expansion would be necessary.

2.2.4 Work Force and Ancillary Facilities

2.2.4.1 Work Force. As of the Second Quarter 1990, the work force at the Golden Sunlight property was 1,030 employees. To meet the Beta Project expansion labor requirements, the number of operations employees would increase to a maximum of ___ in 1993. The work force necessary for the Beta Project would decrease during the years 1994 to 1999 to approximately 300 employees. After mining ends in 2000, the number of employees necessary for the Beta Project would be reduced to about 240. This workforce would continue to process ore from the stockpiles until 2006. After 2006, only a reclamation crew would continue to work on site on this project. Table 2-8 shows projected changes in the work force for the Beta Project to the year 2006.

As of the Second Quarter 1990, ___ contractor employees were on site to handle satellite mining operations and minor construction projects. This number would range from 60 per month to a peak of 310 in the summer months 1991 during the mill expansion and construction of the additional autoclaves. In 1992, construction employees would range from 20 to 150 per month. The construction personnel would decrease sharply after the major construction projects are completed by the end of 1992.

2.2.4.2 Ancillary Facilities. Existing ancillary facilities were described in Section 2.1.5. Additional expansions would be necessary for the proposed Beta Project operations, as described below.

Mine Maintenance Building. The mine maintenance building has been expanded, under previous approvals, to accommodate all planned increases in the mobile equipment fleet. The expansion involved the addition of truck bays on the east side of the existing building, specifically for the maintenance of 100-ton haul trucks, and additional lubrication facilities. A 15-ton crane would be installed to service the new bays, but no other expansion would be necessary.

TABLE 2-8

BARRICK PERSONNEL SUMMARY

Classification	1990[1]	1992	1999	2000	2006
Management	2				
Administration	59				
Employee Relations	24				
Engineering	54				
Environmental	9				
Exploration	18				
Dewatering	27				
Process Operations					
Metallurgy	68				
Operations	110				
Maintenance	55				
Mine Operations					
Mine Operations	426				
Mine Maintenance	203				
TOTAL	1,055				
Total Full-Time Employees	1,039				
Total Temporary Employees	16				
TOTAL	1,055				
Total Salary Exempt	321				
Total Hourly	734				
TOTAL	1,055				

[1] April 30, 1990.

Warehouse. The enclosed storage area at the warehouse facility adjacent to the mine maintenance building has been expanded as part of previous approvals. The expansion has brought the total enclosed storage to approximately 30,000 square feet. The outside fenced storage yard has also been enlarged. No additional expansion would be necessary.

Mill Maintenance Building. The mill maintenance building was built during construction of the oxide mill. This building has been expanded in order to provide full maintenance facilities for all of the mill equipment, including the equipment for the proposed mill expansion for Betze Pit sulfide ore.

Administration Building. The administration building was constructed as approved in 1987. No new administration facilities would be needed.

Safety Building. A new safety building is proposed for construction at the location of the former, temporary safety facility. It would contain offices, areas for emergency equipment, a first aid room, a training room, and an industrial hygiene laboratory. A new fire truck and the existing ambulance would be housed in separate garages near the safety building.

Electrical Facilities. A new 120 kV line will run to the east of the proposed North Block tailings impoundment and will tie into the Boulder Basin Substation which is located at the south-east corner of the AA Block. (A second 120 kV line from Humboldt substation to the Boulder Basin substation is also proposed by Sierra Pacific.) A new substation to handle the increased power demands on the South Block (the Betze Substation) is being constructed in the N 1/4, Section 30, Township 36 North, Range 50 East; this substation will be supplied at 120 kV from the Boulder Basin Substation.

Power for mining operations would originate at the Betze Substation. Power would be distributed to the equipment by powerlines around the pit perimeter and by moveable electrical cables to the mobile equipment and pumps within the pit. A powerline from the Betze Substation would also bring power to the pit area for the pit dewatering system. Power would be transformed down to suitable voltage for use at the wells, sumps, and booster pump stations.

Warehouse. The enclosed storage area at the warehouse facility adjacent to the mine maintenance building has been expanded as part of previous approvals. The expansion has brought the total enclosed storage to approximately 20,000 square feet. The outside fenced storage yard has also been enlarged. No additional expansion would be necessary.

Mill Maintenance Building. The mill maintenance building was built during construction of the oxide mill. This building has been expanded in order to provide full maintenance facilities for all of the mill equipment, including the equipment for the proposed mill expansion for Betze Pit sulfide ore.

Administration Building. The administration building was constructed as approved in 1987. No new administration facilities would be needed.

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The additional electrical demand for the ongoing construction of the 1,500 tpd autoclave circuit and associated oxygen plant would be handled by modifying the existing Mill Substation. Additional powerlines from the existing Mill Substation to the autoclave circuit and oxygen plant are being constructed as approved in January 1989.

The expansion of the mill would increase power demands so that an additional substation would be necessary. It is currently anticipated that the new substation would be located near the existing Mill Substation and be supplied from the Boulder Basin Substation.

A distribution line would be installed to supply power to the North Block tailing impoundment. This distribution line would originate at the Mill Substation, would run north along the west property line of the AA Block, and then follow the tailings and reclaim pipelines route to the North Block tailings impoundment. Table 2-9 presents the incremental and peak power demand for the proposed facilities.

Power is distributed to the ancillary facilities at the plant site by cables in buried ducts. Tie cables would be installed to allow operations to continue in the event of failure of one of the main transformers. Emergency power requirements would be provided by adding additional diesel generators to the existing battery of diesel generators. Should normal power fail, essential loads and services would be powered by the generators.

Water Supply. Existing underground pipelines would be extended to service all new areas. Process water pumps would be refitted to handle the larger flows. Additional water lines and hydrants would be added to the existing fire suppression system.

Propane Supply. New propane pipelines would be installed as necessary to feed the propane to the new boiler house, autoclaves, and additional ancillary facilities.

Sewage Treatment. Additional gravity sewers would be constructed to collect sanitary wastes and would be connected to the existing sewer system. A new sewage treatment plant would be installed at the existing septic system location. Pumps would be installed within existing septic tanks to control feed to the new sewage treatment plant. Effluent from the

The additional electrical demand for the ongoing conversion of the 1,500 tpd autoclave circuit and associated oxygen plant would be handled by modifying the existing Mill Substation. Additional powerlines from the existing Mill Substation to the autoclave circuit and oxygen plant are being constructed as approved in January 1990.

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TABLE 2-9

ELECTRICAL POWER FORECAST - PEAK DEMAND

Year	Anticipated Equipment Addition	Incremental Demand (MW)	Total Power Peak Demand (MW)
1989	---	---	19.3
1990	#1 Oxygen Plant	3.5	
	Betze Pit	5.0	
		8.5	27.8
1991	#2 Autoclave	1.1	
	#3 Autoclave	1.1	
	Betze Pit	6.0	
	#2 Oxygen Plant	13.7	
	Sulfide Mill	7.0	
		28.9	56.7
1992	#4 Autoclave	3.3	
	#5 Autoclave	1.1	
	#6 Autoclave	1.1	
	#3 Oxygen Plant	10.2	
		15.7	72.4
	Total Peak Demand		72.4

new sewage treatment plant would continue to be pumped to the mill for disposal in the tailings impoundment.

Fuel Storage. Existing fuel storage would be expanded by adding new tanks capable of holding a total of 250,000 gallons of diesel fuel. The new fuel storage area would be bermed and lined with high density polyethylene to contain any spills. Fire suppression design would be incorporated into the storage area to minimize the danger to personnel and damage to structures in the event of an accident. An additional bermed storage area would be constructed to contain an antifreeze tank and its related dispensing system.

Roads. Yard areas would continue to be excavated or filled to a uniform grade. Service roads would be designed and constructed for the anticipated loads. Drainage crossings at road fills would be constructed with corrugated metal pipes sized and sloped to pass the flow from the 25-year, 24-hour precipitation event.

Ditches would be constructed along the uphill margins of roads where they are cut into the uphill terrain. The ditches would be sized as appropriate to divert the runoff from the uphill areas along the margin of the road to the nearest drainage channel. The outer margins of road fills would be fitted with drainage control berms to collect and route runoff along the road surface and away from the outer slopes of the fills.

Communications. The existing microwave system would be expanded to 48 channels. It is expected that mine expansion would require the relocation of the existing microwave repeater station. The on-site telephone system would also be expanded.

Explosives Storage. The existing powder magazine is within a 12-foot high earthen barricade which is approximately 330 feet long by 400 feet wide. An expansion of the powder magazine within the existing earthen barricade is proposed to meet the increased blasting demands associated with the Betze Pit development.

2.2.5 Reclamation

BLM's Surface Management Regulations and Nevada's recently adopted Mining Reclamation Act require a plan for the reclamation of the affected area and establishment of a surety sufficient to implement the plan. The proposed reclamation measures discussed in this section were selected by Barrick to conform to the general standards set forth in the Mining Reclamation Act. Regulations implementing that Act have not been completed; however, once completed, they may specify additional or different reclamation measures than those proposed by Barrick.

The long-term goals for reclamation in the Act are to leave areas disturbed by mining in a stable configuration that will withstand erosion and slump failure and to establish a diverse self-renewing plant community that at least equals or exceeds that which existed before development. The Act requires that all buildings, structures, and equipment be removed from the surface and disposed of properly, and to the extent feasible and reasonable, mining disturbances be sloped to blend and match the natural surrounding topography.

Specific reclamation measures presently proposed by Barrick are discussed below. The final selection of specific reclamation measures and the schedule for implementation of such measures will be determined by NDEP and BLM on a case-by-case basis.

2.2.5.1 Topsoil Stripping and Stockpiling. In areas slated for disturbance, the topsoil would be salvaged using conventional construction equipment such as bulldozers, front-end loaders and trucks, and scrapers. Topsoil depths would vary from area to area, and efforts would be made to salvage all available topsoil. Topsoil would then be stockpiled in designated storage areas for future use in reclamation.

Topsoil stockpiles would be located to minimize impacts from the operations and would be graded to slopes of 2.5H:1V to reduce erosion. The surfaces of the topsoil piles would be reseeded during the first fall season following construction to minimize the spread of noxious weeds and soil loss to wind and water erosion. Diversion channels would be constructed around the topsoil stockpiles to protect the stockpiles from surface water flows, and stockpiles would be marked with appropriate signs.

In order to reduce rutting and limit soil erosion during construction and operation, excessive traffic would be curtailed on areas where topsoil

would not be removed. Soils that would be disturbed during construction activities would be restored as soon as possible following construction.

2.2.5.2 Waste Rock Disposal Areas. The waste rock disposal areas would be constructed by dumping laterally in vertical lifts. Each lift would be pulled back sufficiently to leave a terrace at its base to control runoff and erosion. During reclamation, the slope of each lift would be modified from the natural angle of repose to allow topsoil placement and operation of reclamation equipment. The final overall slope would be approximately 2.5H:IV (Figure 2-9). Topsoil would be spread uniformly over the surface and revegetated with approved seed mixtures.

2.2.5.3 Heap Leach Facilities. During closure the heaps would be rinsed with water or a solution containing a cyanidicide. The heaps would be considered to be stable with respect to cyanide discharge when the weak-acid-dissociable (WAD) cyanide levels met the regulations established by the Nevada Division of Environmental Protection. Any remaining solution in the solution collection ponds would be evaporated or removed and treated. The primary pond liners would then be folded with any precipitate contained inside, and would either be buried in place or delivered to an approved disposal facility in compliance with Nevada regulations. The ponds would be breached or backfilled. The heaps would be regraded to slopes of approximately 2.5H:lV, covered with topsoil, contoured to control erosion, and revegetated.

2.2.5.4 Mill and Ancillary Facilities. Upon closure, the mill and ancillary facilities would be dismantled and removed from the millsite and other areas. Foundations, basements, walls, and sumps would be flattened or otherwise covered with earth. The top surfaces of the disturbed areas would be graded to blend into the configuration of the natural topography. Any steep cut-and-fill slopes would be regraded to a slope of 2.5H:lV or gentler. The tops of the slopes would be rounded slightly to help match the slopes with the appearance of the surrounding natural terrain.

Road fills and drainage crossings would be regraded to a natural shape and gradient, and culverts would be removed. Drainage crossings would not be regraded if they are part of roads that have a post-mining use as determined by the BLM. Dikes and ditches that are no longer required for

would not be removed. Soils that would be disturbed during construction activities would be restored as soon as possible following construction.

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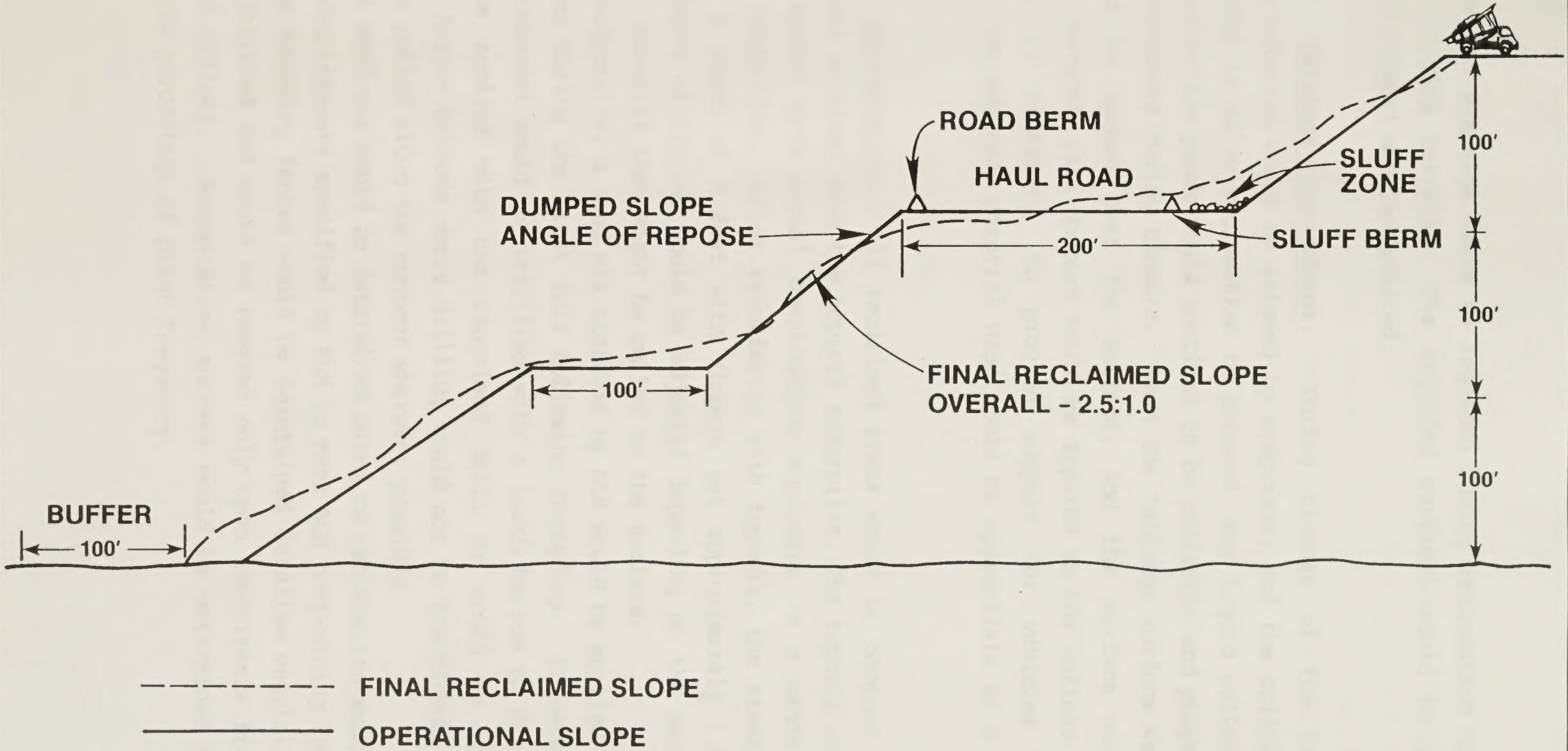

BETZE DEVELOPMENT PROJECT

Figure 2-9. Waste Dump Slopes

control of surface drainage would be regraded during reclamation to blend with the surrounding terrain. The regraded surfaces would be covered uniformly with topsoil and revegetated.

2.2.5.5 Tailings Impoundment. During closure of the tailings impoundments, solution would be allowed to evaporate, and the solids would dry sufficiently to allow reclamation to proceed. Any liquid collected in the seepage collection ponds would continue to be collected and pumped back into the impoundments during closure. When the tailings surface was dry, topsoil would be spread over the surface, and the surface would be revegetated. Subgrade rock support would be applied to the surface of the impoundments, if necessary, to provide support for vehicles during reclamation. The subgrade material used would be appropriate as a growth medium.

2.2.5.6 Revegetation. All reclaimed areas would be covered with a layer of topsoil obtained from the topsoil stockpiles. The topsoil would be applied and spread with normal construction equipment in a manner that would reduce compaction. After resurfacing with topsoil, the areas would be ripped to a depth of 2 feet with rippers set approximately 1.5 feet apart. The depth of ripping would be adjusted depending on the amount of rock or cobble material that might be pulled to the surface.

During reclamation, a seed mix approved by BLM would be applied to all topsoiled areas during the first fall following regrading. If necessary, areas to be reseeded would be scarified with a tooth harrow or disk. The seed would be applied with the rangeland drill or would be sown by broadcast and harrow methods where drilling would not be practicable. The drill would be pulled along the contour wherever possible.

The final seed mix would be determined based on reclamation success to date and the requirements specified by BLM to meet BLM post-mining land use criteria. The boundary fences would be maintained to allow vegetation to become re-established and would be removed only upon concurrence from the BLM authorized officer. Revegetation success would be determined by the BLM as a certain percentage of plant frequency.

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The final seed mix would be determined based on reclamation success to date and the requirements specified by BLM to meet BLM post-mining land use criteria. The boundary fences would be maintained to allow vegetation to become re-established and would be removed only upon concurrence from the BLM authorized officer. Revegetation success would be determined by the BLM as a certain percentage of plant frequency.

2.3 Project Alternatives

A mining project, the location of which is limited by the location and ownership of an ore deposit, generally lends itself to analysis by its various operational components. The comments received during the scoping process were frequently aimed at one or more specific components. Therefore, the discussion of alternatives in this EIS is generally framed in terms of alternative components of the project rather than alternative formulation of the entire project. This format allows alternative components to be combined and allows consideration of a wider variety of formulations of the project as a whole.

Project alternatives were selected for analysis in the EIS based on various criteria, including:

- public or agency issue or concern;
- technical or economic feasibility;
- potential environmental advantage; and
- relationship to the expressed purposes and needs of Barrick for the project.

Alternatives were considered in detail for the following components:

- waste rock disposal locations;
- ore stockpile locations;
- heap leach pad locations;
- tailings impoundment locations;
- water handling; and
- reclamation.

This section also addresses alternatives initially considered but eliminated from detailed analysis, the alternative of no action, and BLM's preferred alternative.

2.3.1 Alternatives Considered in Detail

2.3.1.1 Waste Rock Disposal Area Locations. While a single waste rock storage area could contain the 815.2 million tons of waste rock from the Post and Betze Pits, a combination of storage areas may be more

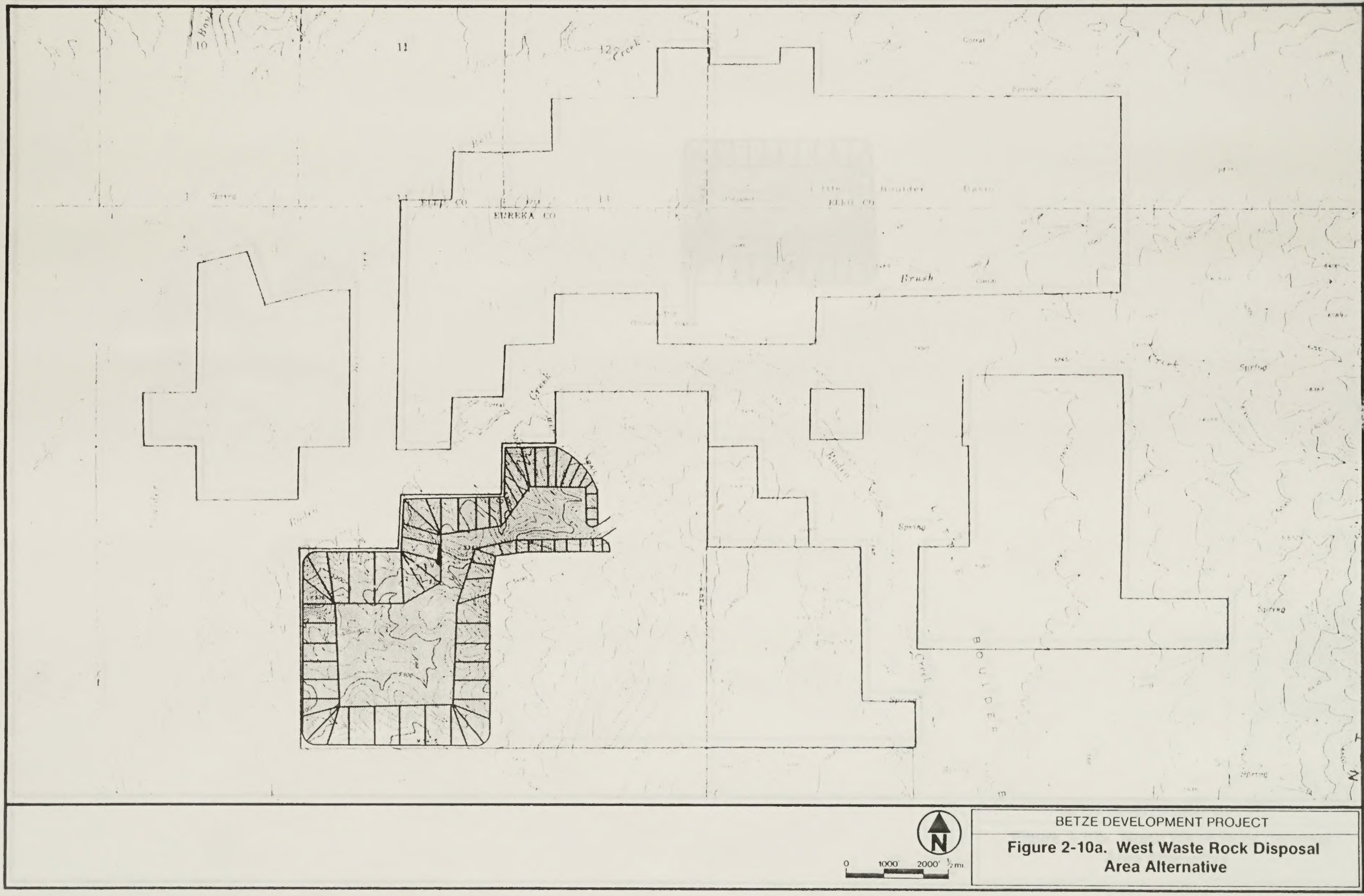
cost-effective or responsive to environmental concerns. In addition to alternative sites, it is also possible, within certain limits, to vary the capacity or the specific boundaries of each waste disposal area from those described and depicted in this analysis. Alternative configurations to the proposed action include:

- West Area. This alternative would be located in the western portion of the South Block. This proposed waste rock disposal area, southwest of the Betze Pit, could contain approximately 508 million tons of waste rock to an elevation of 5,800 feet. The height of the waste rock disposal area would be approximately 500 feet above the original ground elevation on its north and west boundaries and approximately 400 feet on its south and east boundaries. It would be approximately 810 acres in size. Access from the Betze Pit would be from the southeast and northwest margins of the Betze Pit; the maximum haul distance would be approximately 4 miles one way. The West waste rock disposal area is illustrated in Figure 2-10a.

- North Area. This alternative would be located in the North Block, in the area proposed for the expanded heap leaching operations. This waste rock disposal area could contain approximately 155 million tons of waste rock to an elevation of 5,700 feet. The waste rock disposal area would be approximately 300 feet in height and approximately 450 acres in size. Access from the Betze Pit would be from the northeast and northwest margins of the Betze Pit; the maximum haul distance would be approximately 2 miles one way. The North waste rock disposal area is illustrated in Figure 2-10b.

- Clydesdales Area. This alternative would be located primarily on land controlled by Barrick, but would extend beyond the property boundaries in certain areas in order to maximize the storage volume. Barrick would have to make arrangements with other landowners. The Clydesdales waste rock disposal area could contain up to 440 million tons, would disturb approximately 721 acres, and would have a maximum elevation of 5,550 feet. Nearest access from the Betze Pit would be from the northwest end of the pit, a distance of approximately 1.2 miles, but the longest haul distance would be closer to 2.3 miles one way. Figure 2-10c illustrates the Clydesdales waste rock disposal area.

- Far West Area. This alternative is a variation of the proposed Extended South Block waste rock disposal area. While utilizing all of the South Block, this alternative would extend beyond Barrick's property boundaries to the south and west to increase the available volume. Developing this alternative would require Barrick to make arrangements with third parties, which either own or manage the adjacent lands. The Far West waste rock disposal area could contain up to 2.01 billion tons of waste rock, would disturb approximately 2,559 acres, and would, if fully utilized, have a maximum elevation of 5,900 to 6,000 feet. Access from the



BETZE DEVELOPMENT PROJECT

Figure 2-10a. West Waste Rock Disposal Area Alternative

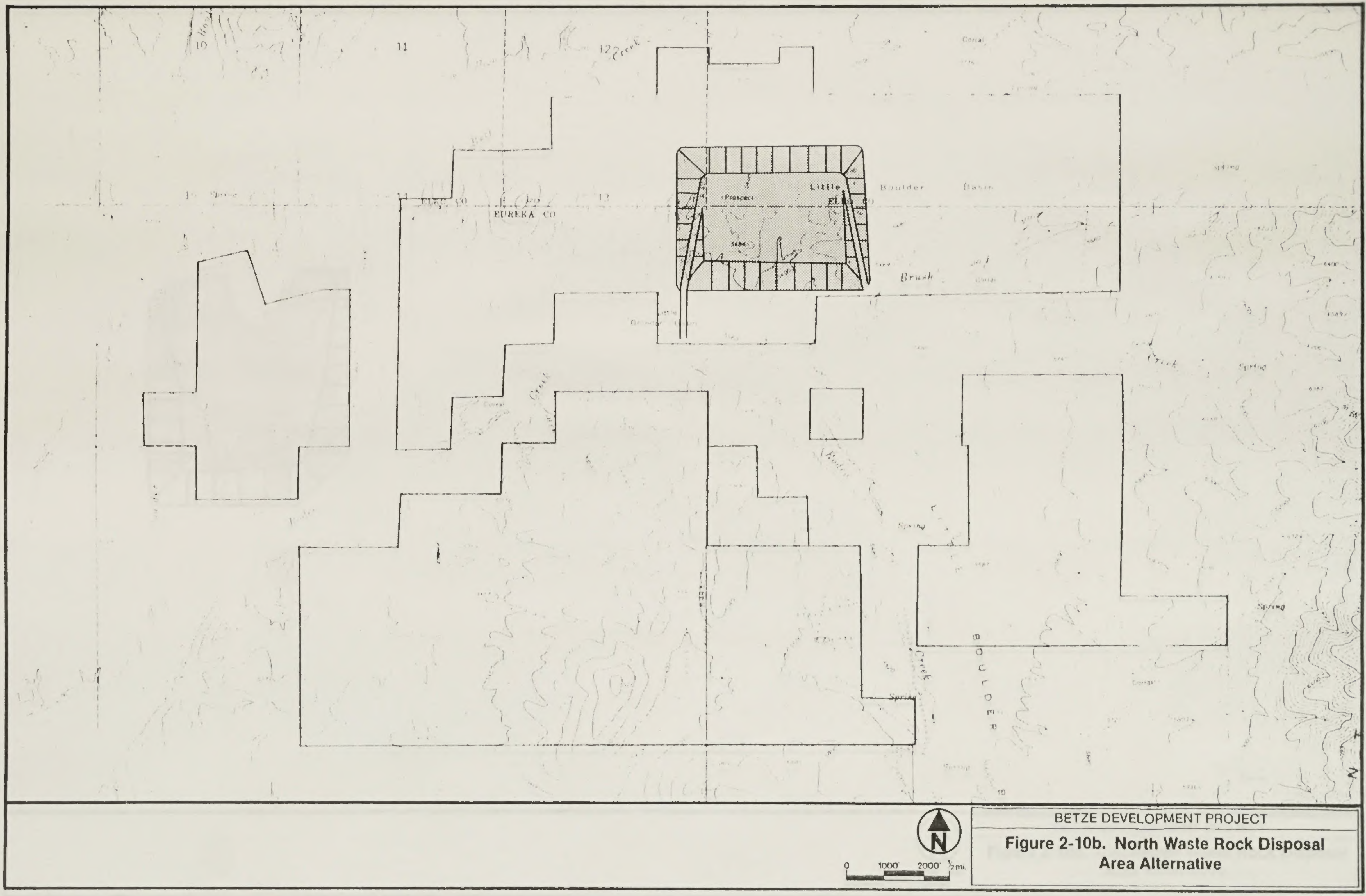
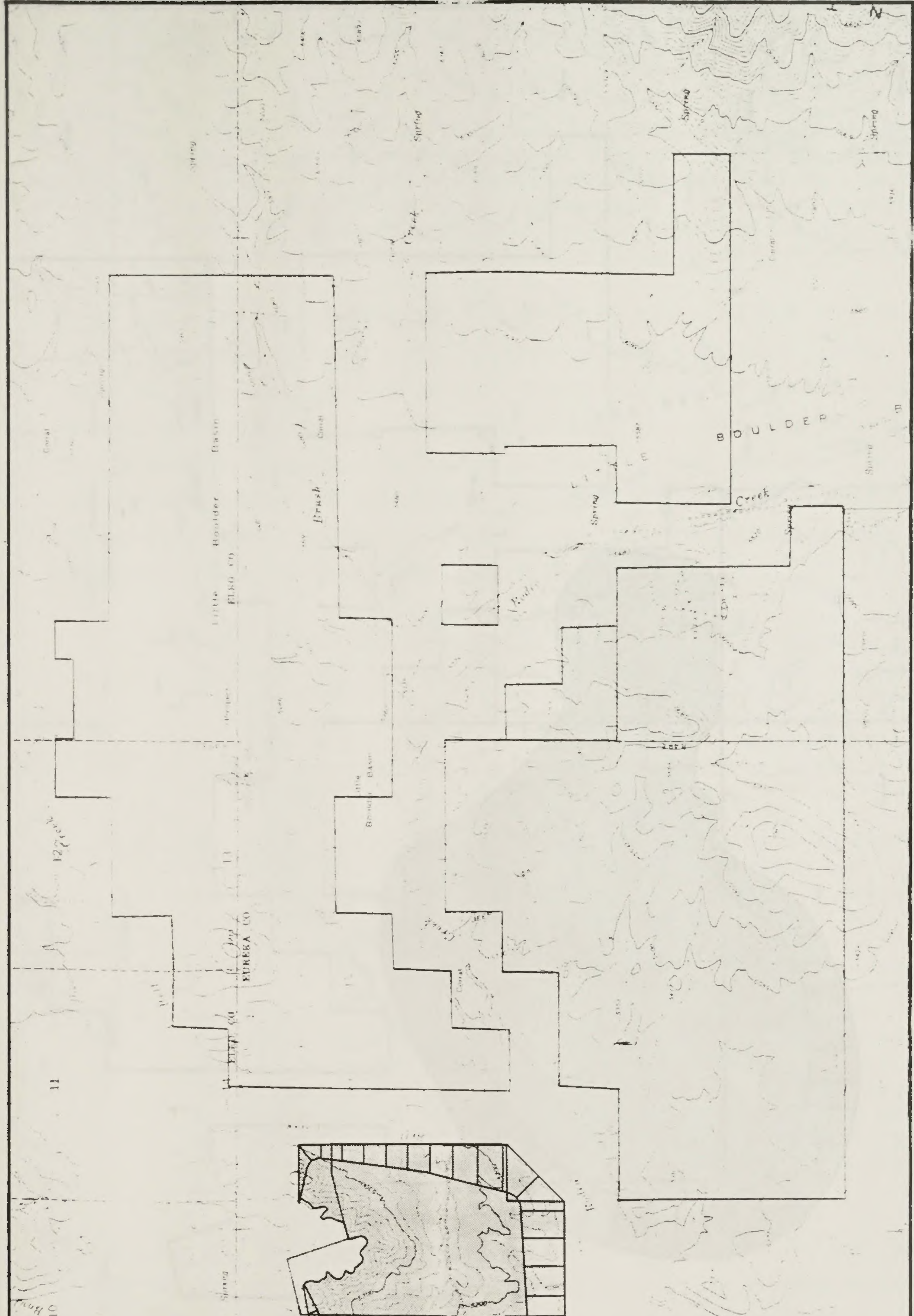


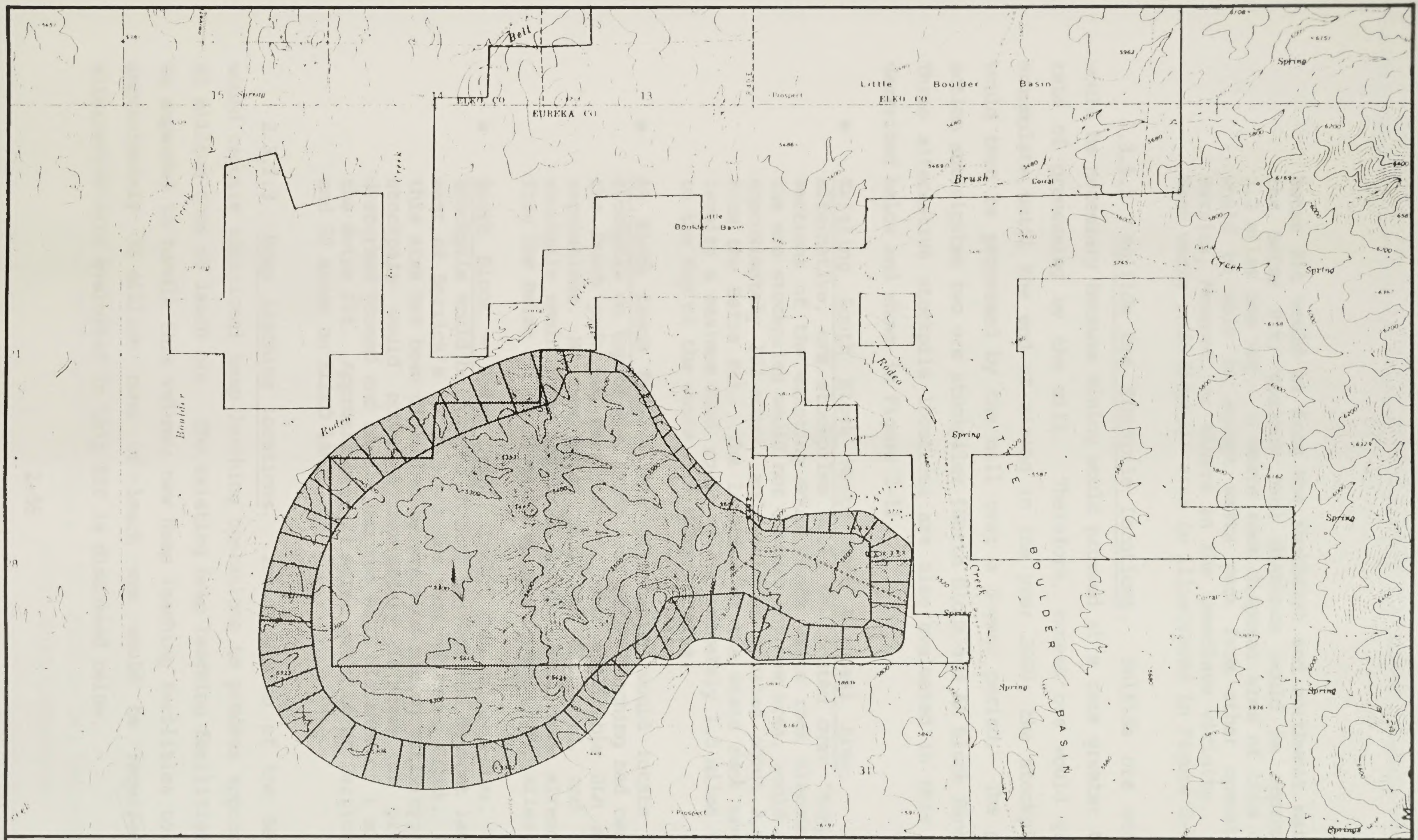
Figure 2-10b. North Waste Rock Disposal Area Alternative



BETZE DEVELOPMENT PROJECT

Figure 2-10c. Clydesdale Waste Rock Disposal Area Alternative

Figure 2-10c. Cyp[illegible] Waste Rock Dump Area Alternative



BETZE DEVELOPMENT PROJECT

Figure 2-10d. Far West Waste Rock Disposal Area Alternative

Betze Pit would be from the southeast and northwest margins of the Betze Pit; maximum haul distance would be approximately 2.2 miles one way. A waste rock disposal area of this capacity would be able to accept waste rock from other operations of Barrick, Newmont, or others in the immediate vicinity. The Far West waste rock disposal area is illustrated in Figure 2-10d.

2.3.1.2 Sulfide Ore Stockpile Locations. Sulfide ore stockpiles would be necessary because mining would proceed at a rate greater than the rate of processing by the mill. Therefore, excess ore would gradually accumulate until the end of mining in the year 2000; the stockpiled ore would then be processed by the mill over a 6-year period. The proposed action anticipates two ore stockpiles (North Block and AA Block Panhandle). Three alternative stockpile locations are also evaluated in this EIS, as described below and shown in Figure 2-11.

- Existing South Block Waste Rock Disposal Area. In this alternative, ore stockpiles would be located over "topped out" sections of the existing South Block waste rock disposal area. The ore stockpiles would not disturb any new area, would comprise approximately 102 acres, and would be located about 2,000 feet from the Betze Pit. The location of the waste rock area would require a maximum haul route of approximately 1.5 miles to climb to the top of the waste rock disposal area.

- AA Block Leach Pads. This alternative would locate the ore stockpile on top of the leach pads after leaching had ceased and the leach pads had been closed under applicable BLM and NDEP regulations. No new areas would be disturbed, and the ore stockpile would cover nearly 80 acres. Haul roads already exist from the Betze Pit, a distance of approximately 1.3 miles.

- South Block - Rodeo Creek. Under this alternative, the ore stockpile would be located on both Barrick and Newmont lands just east of Barrick's South Block but west of Rodeo Creek. Most of this area has been disturbed by previous mining activity; the ore stockpile would cover approximately 74 acres of previously disturbed ground and have a maximum haul distance of 1 mile from the Betze Pit. Approximately 24 acres would be on Barrick claims and 50 acres on ELLCO lands.

2.3.1.3 Heap Leaching Locations. The expansion of the Betze Pit would require additional heap leaching operations to process approximately 62 million tons of leach ore. The existing heap leaching facilities cannot be expanded to handle this volume; new heap leaching facilities to process approximately 35 million tons of leach ore would be required. An alternative site evaluated in this EIS is discussed below.

Betze Pit would be from the southeast and northwest margins of the Betze Pit; maximum haul distance would be approximately 1.2 miles one way. A waste rock disposal area of this capacity would be able to accept waste rock from other operations of Barrick, Newmont, or others in the immediate vicinity. The Far East waste rock disposal area is illustrated in Figure 2-10D.

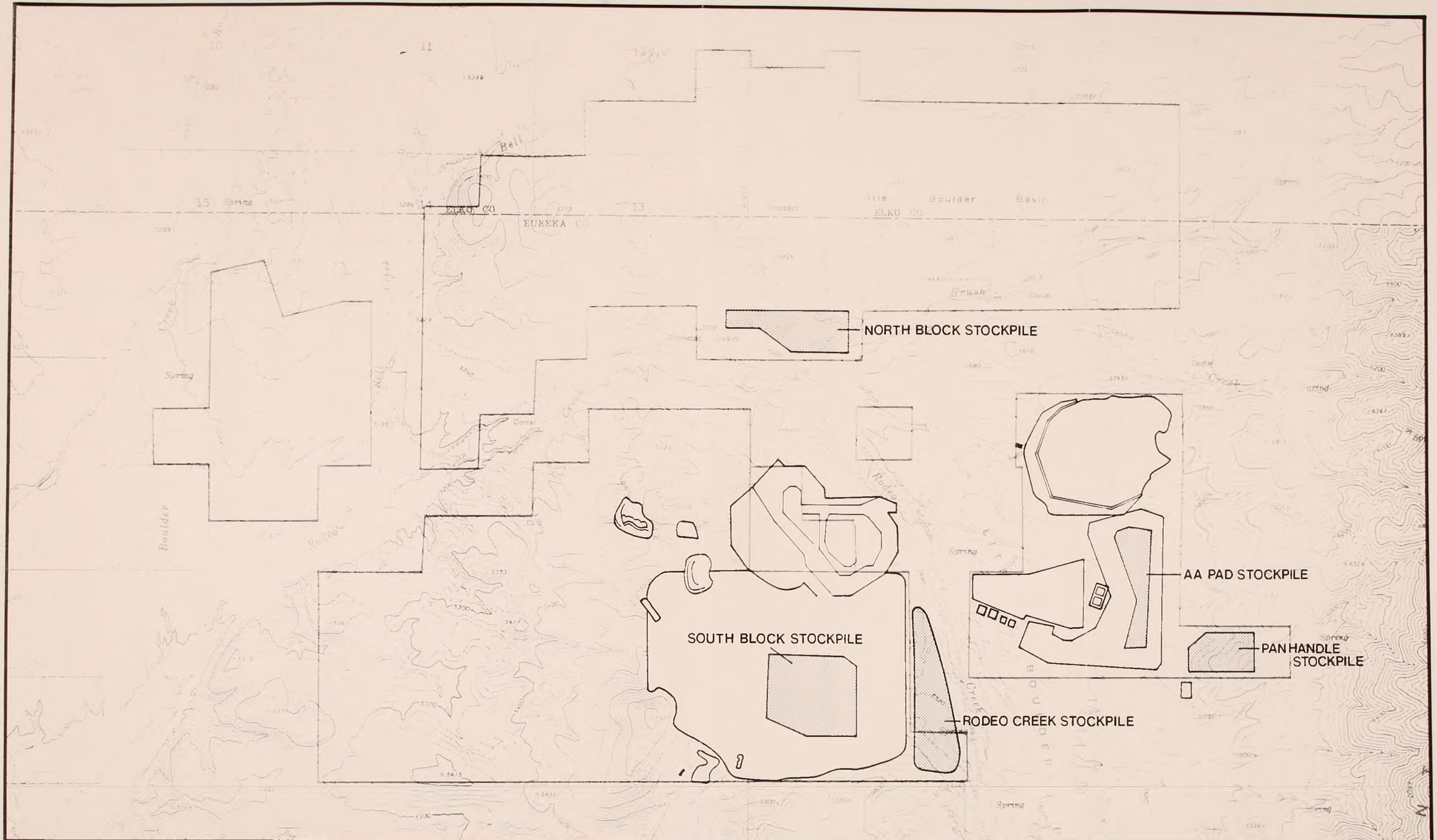
2.3.1.2 Sulfide Ore Stockpile Locations. Sulfide ore stockpiles would be necessary because mining would proceed at a rate greater than the rate of processing by the mill. Therefore, excess ore would gradually accumulate until the end of mining in the year 2000; the stockpiled ore would then be processed by the mill over a 6-year period. The proposed action anticipates two ore stockpiles (North Block and AA Block Recontour). Three alternative stockpile locations are also evaluated in this EIS, as described below and shown in Figure 2-11.

- Existing South Block Waste Rock Disposal Area. In this alternative, ore stockpiles would be located over "topped out" sections of the existing South Block waste rock disposal area. The ore stockpiles would not disturb any new area, would comprise approximately 102 acres, and would be located about 2,000 feet from the Betze Pit. The location of the waste rock area would require a maximum haul route of approximately 1.5 miles to climb to the top of the waste rock disposal area.

- AA Block Leach Pads. This alternative would locate the ore stockpile on top of the leach pads after leaching had ceased and the leach pads had been closed under applicable BLM and NDEP regulations. No new areas would be disturbed, and the ore stockpile would cover nearly 80 acres. Haul roads already exist from the Betze Pit, a distance of approximately 1.3 miles.

- South Block - Rodeo Creek. Under this alternative, the ore stockpile would be located on both Barrick and Newmont lands just west of Barrick's South Block but east of Rodeo Creek. Most of this area has been disturbed by previous mining activity; the ore stockpile would cover approximately 74 acres of previously disturbed ground and have a maximum haul distance of 1 mile from the Betze Pit. Approximately 24 acres would be on Barrick claims and 50 acres on Carlin lands.

2.3.1.3 Heap Leaching Locations. The expansion of the Betze Pit would require additional heap leaching operations to process approximately 12 million tons of leach ore. The existing heap leaching facilities cannot be expanded to handle this volume; new heap leaching facilities to process approximately 15 million tons of leach ore would be required. An alternative site evaluated in this EIS is discussed below.



NOTES: AA Pad Stockpile is on top of leached out AA Leach Pad.
South Block Stockpile is on top of completed South Dump.

0 1000' 2000' ½ mi.

BETZE DEVELOPMENT PROJECT

Figure 2-11. Sulfide Ore Stockpiles – Alternative Locations

- Western North Block. This alternative would locate the heap leaching operations in the southwest corner of the North Block. The heap leaching operations would disturb approximately 175 acres and would require the realignment of the existing Bootstrap haul road. Figure 2-12 shows the alternative leach pad location and the Bootstrap haul road. Similar to the proposed action to construct the additional heap leaching facilities in the central portion of the North Block, the alternative would require the construction of heap leach pads, solution collection ponds, a gold recovery facility (carbon columns), and associated infrastructures. The gold-loaded carbon would be trucked to the existing facility on the AA Block for carbon stripping, electrowinning, and refining.

2.3.1.4 Tailings Impoundment Location. The expansion of the Betze Pit would require storage volume for approximately 60 million tons of tailings. The existing tailings impoundment cannot be expanded to contain this volume. The alternative sites and configurations evaluated in this EIS are discussed below.

- Expanded East Area of North Block. This alternative is similar to the Proposed Action in that the general location is the same, but the impoundment is larger in all dimensions. The centerline length of the embankment would be approximately 3.2 miles, and the total disturbed area would be approximately 703 acres. The impoundment would have capacity for approximately 108 million tons of tailings. A tailings impoundment of this capacity would be able to accept tailings from other operations of Barrick, Newmont, or others within the immediate vicinity. This alternative is shown on Figure 2-13a.

- Central Area of North Block. This tailings impoundment alternative is based on the assumption that all waste rock could be disposed of in other locations, thus freeing the central area of the North Block for the construction of a tailings impoundment. The embankment in this location would have a centerline length of 1.6 miles, and the total disturbed area would be approximately 613 acres. The impoundment could contain approximately 45 million tons of tailings; the location is shown in Figure 2-13b.

- Capacity Adjustment. This alternative would involve increasing the capacity of the existing impoundment in the AA Block together with a smaller impoundment at either the proposed tailings impoundment location or at one of the alternative locations described above. Increasing the capacity of the existing impoundment would involve increasing both the height and length of the existing embankment (by using side embankments). Space within Barrick's property boundary at the existing impoundment location is very limited, and any significant expansion would require Barrick to make arrangements with ELLCO, the adjacent

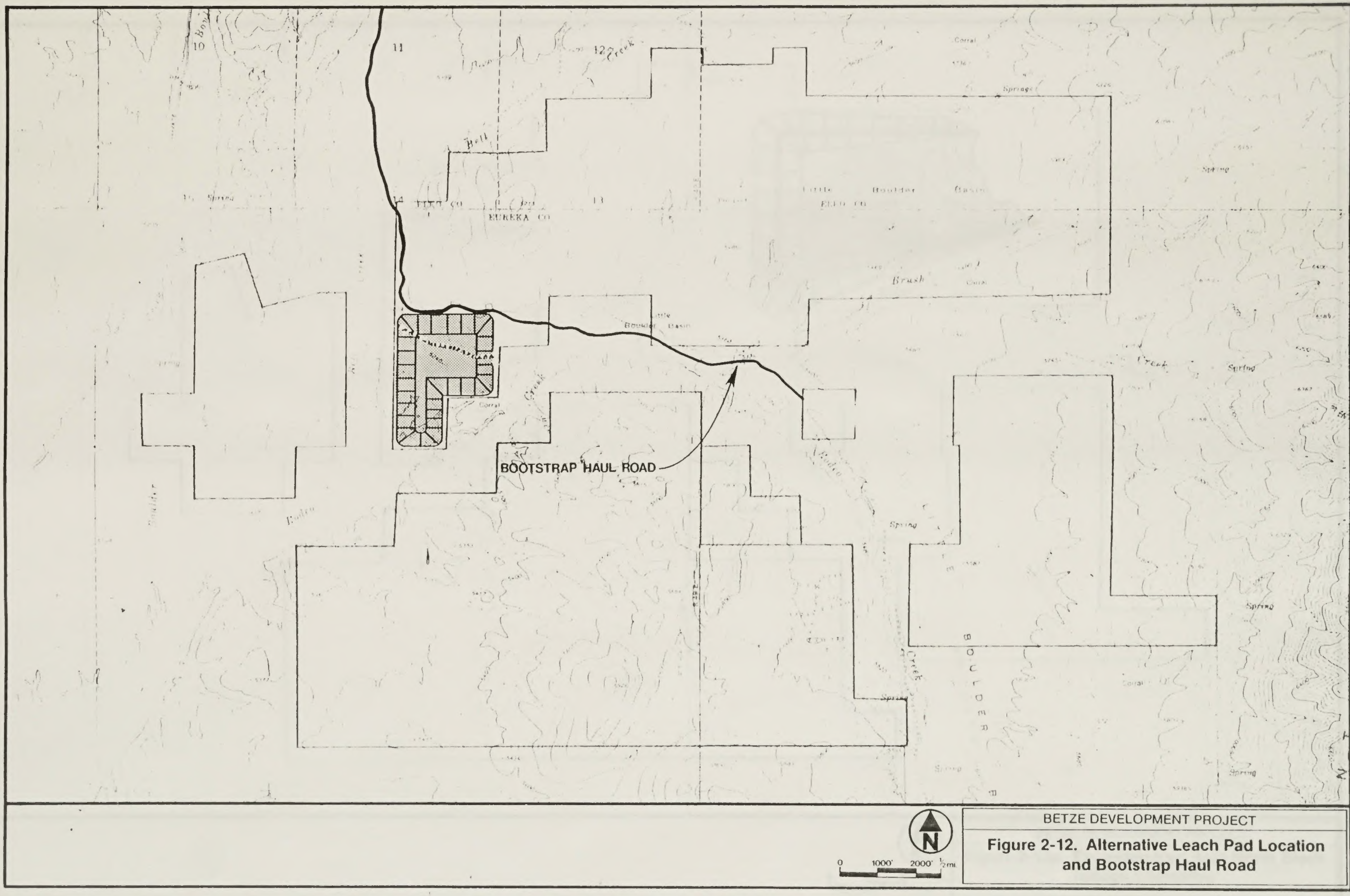
- Western North Block. This alternative would locate the heap leaching operations in the southwest corner of the North Block. The heap leaching operations would disturb approximately 175 acres and would require the realignment of the existing Bootstrap haul road. Figure 2-12 shows the alternative leach pad location and the Bootstrap haul road. Similar to the proposed action to construct the additional heap leaching facilities in the central portion of the North Block, the alternative would require the construction of heap leach pads, solution collection ponds, a gold recovery facility (carbon columns), and associated infrastructures. The gold-loaded carbon would be trucked to the existing facility on the AA Block for carbon stripping, electrowinning, and refining.

2.3.1.4 Tailings Impoundment Location. The expansion of the Betze Pit would require storage volume for approximately 60 million tons of tailings. The existing tailings impoundment cannot be expanded to contain this volume. The alternative sites and configurations evaluated in this EIS are discussed below.

- Expanded East Area of North Block. This alternative is similar to the Proposed Action in that the general location is the same, but the impoundment is larger in all dimensions. The centerline length of the embankment would be approximately 2.2 miles, and the total disturbed area would be approximately 701 acres. The impoundment would have capacity for approximately 109 million tons of tailings. A tailings impoundment of this capacity would be able to accept tailings from other operations of Barrick, Newmont, or others within the immediate vicinity. This alternative is shown on Figure 2-13a.

- Central Area of North Block. This tailings impoundment alternative is based on the assumption that all waste rock could be disposed of in other locations, thus freeing the Central area of the North Block for the construction of a tailings impoundment. The embankment in this location would have a centerline length of 1.6 miles, and the total disturbed area would be approximately 613 acres. The impoundment could contain approximately 48 million tons of tailings; the location is shown in Figure 2-13b.

- Capacity Adjustment. This alternative would involve increasing the capacity of the existing impoundment in the AA Block together with a smaller impoundment at either the proposed tailings impoundment location or at one of the alternative locations described above. Increasing the capacity of the existing impoundment would involve increasing both the height and length of the existing embankment (by using side embankments). Space within Barrick's property boundary at the existing impoundment location is very limited, and any significant expansion would require Barrick to make arrangements with ELLCO, the adjacent



BETZE DEVELOPMENT PROJECT

Figure 2-12. Alternative Leach Pad Location and Bootstrap Haul Road

Figure 2-12. Alternative Leach Pad Locatio
and Bootstrap Haul Road

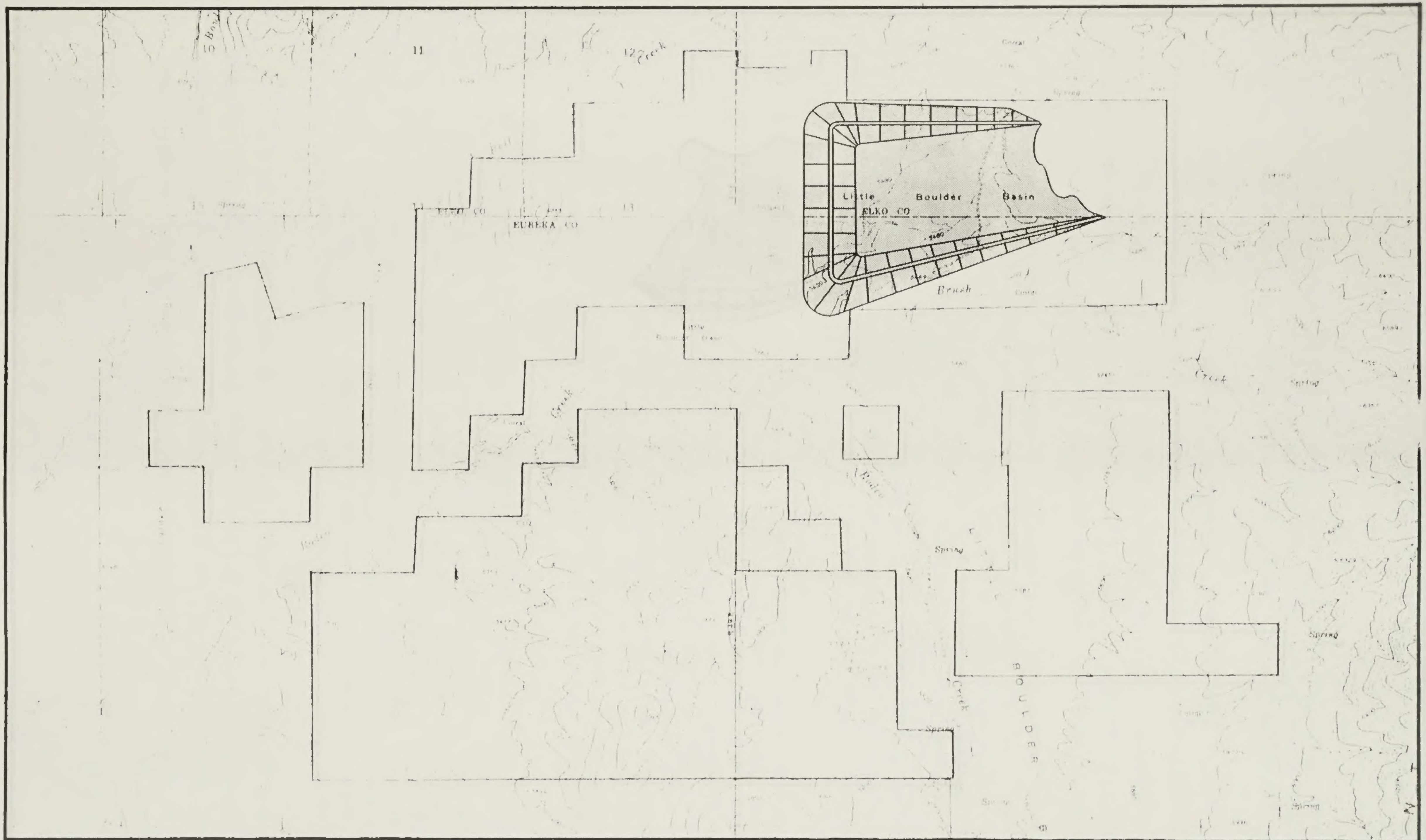


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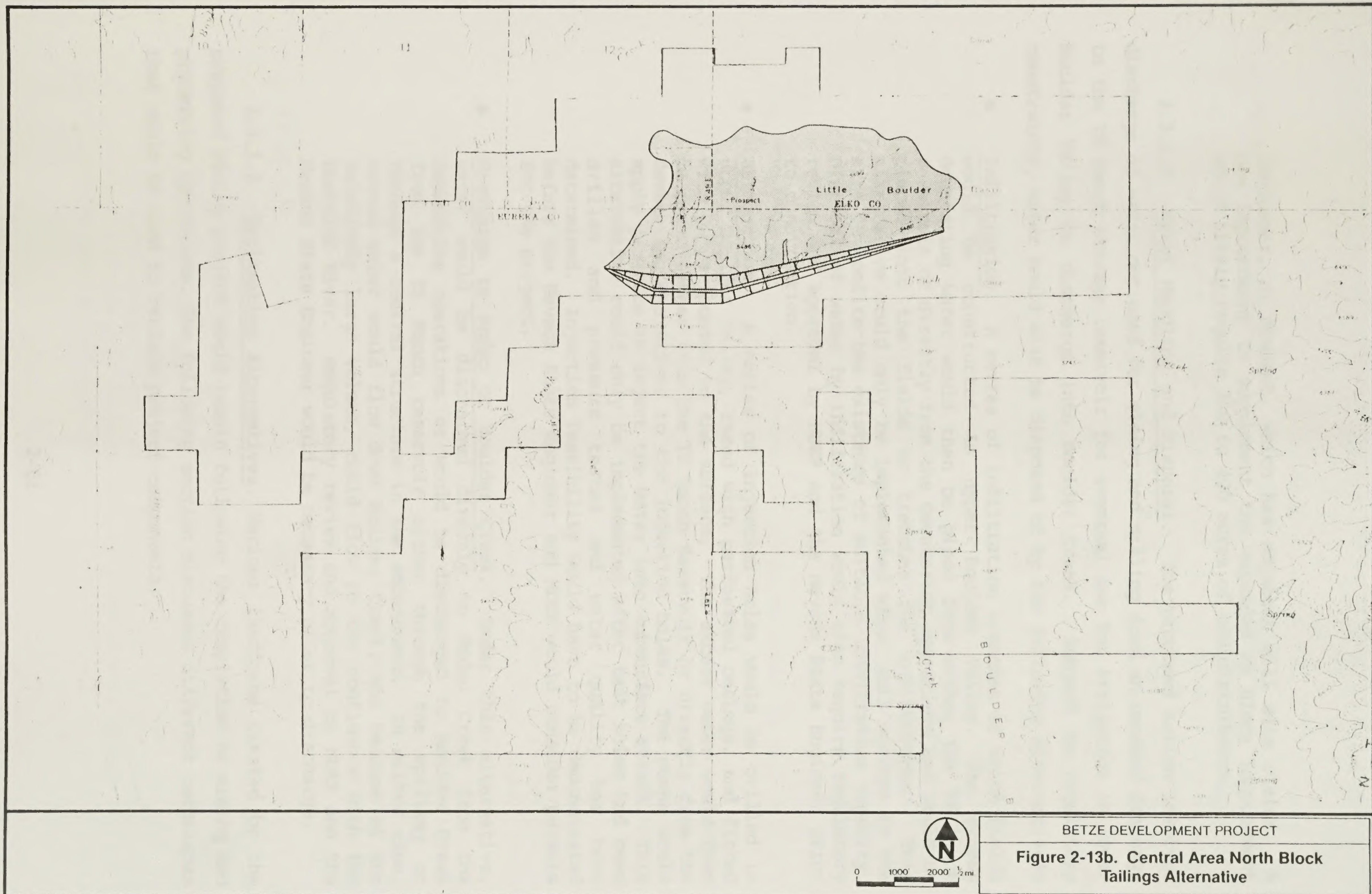
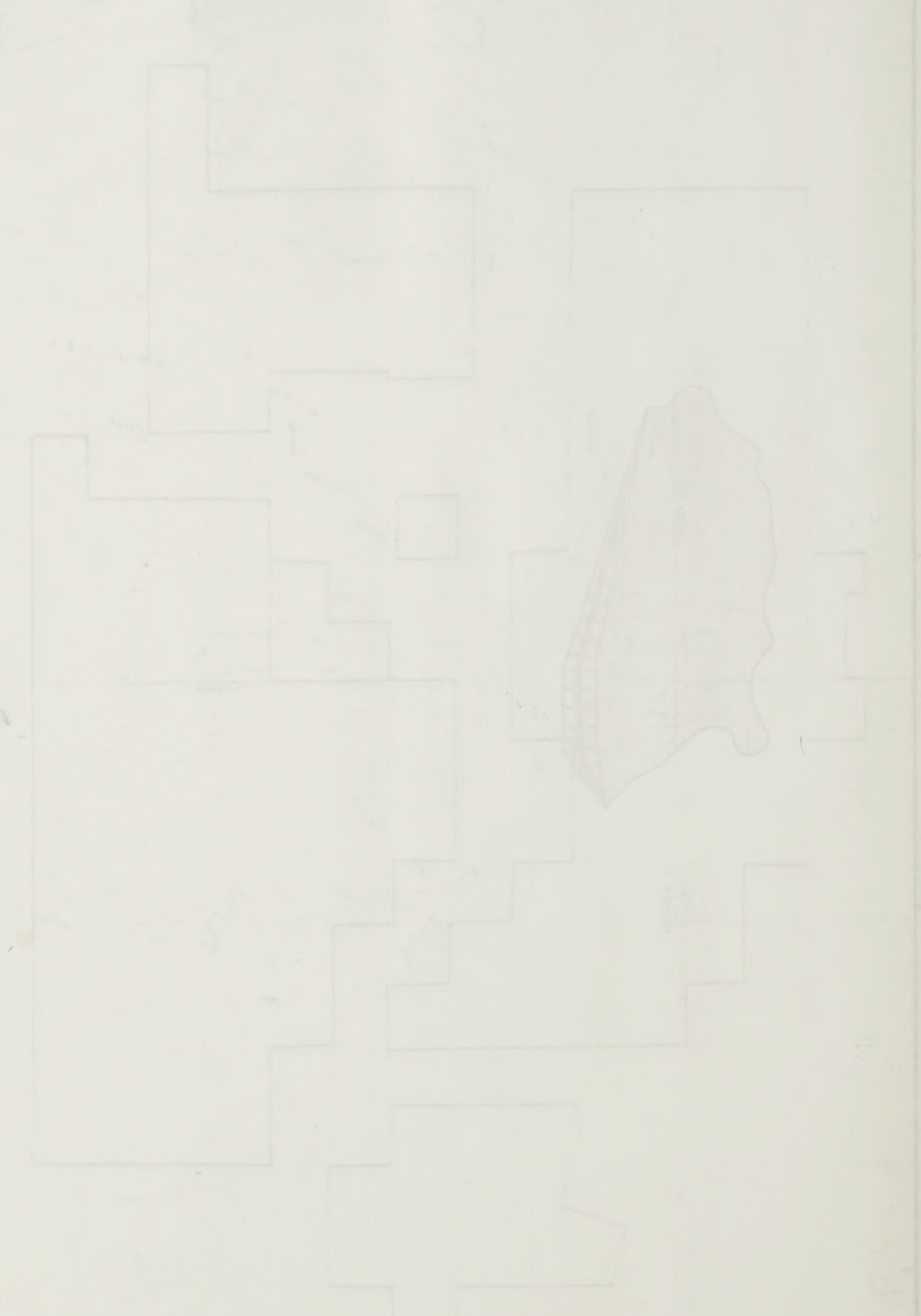
Figure 2-13a. Expanded East Area North Block Tailings Alternative



BETZE DEVELOPMENT PROJECT

Figure 2-13b. Central Area North Block Tailings Alternative



landowner, or Newmont, which has adjacent mill site claims. A new impoundment to supplement the expanded AA Block impoundment would likely require 300 to 400 acres of new disturbance.

2.3.1.5 Water Handling and Disposal. The proposed action involves discharge of water not used for mining and milling down an unnamed drainage to the TS Ranch storage reservoir for eventual use for irrigation in lower Boulder Valley or discharge into Boulder Creek. Subject to regulatory constraints, water could also be disposed of by the following alternatives:

- Infiltration. A series of infiltration trenches or ditch fields would be constructed in upper Boulder Valley. The excess dewatering water would then be piped from either the TS Ranch reservoir or directly from the dewatering operations and would be placed into the fields or trenches for infiltration. This alternative could only be implemented after soil surveys in the area to confirm the existence of suitable infiltration capacity. Disposal of water by infiltration would also require regulatory review and approval by NDEP and the Nevada State Engineer prior to construction.

- Reinjection. A series of injection holes would be drilled in upper Boulder Valley, cased with perforated casings, and fitted with pumps mounted on the surface. The excess water would then be piped either from the TS Ranch Reservoir or directly from the dewatering operations to the injection holes. The pumps would apply pressure to inject the water into subsurface strata. This alternative could only be implemented after test holes had been drilled and pressure tested and water quality has been determined. Injection feasibility would have to be demonstrated before the Nevada State Engineer and NDEP would consider permits for the project.

- Discharge to Rodeo or Boulder Creek. Under this alternative, water would be discharged directly to Rodeo Creek from the dewatering operations or would be discharged to Boulder Creek from the TS Ranch reservoir either through the spillway or through a control structure in the embankment. In either case, excess water would flow down Boulder Creek, and because of the relatively large volume, could flow to the confluence with the Humboldt River. Regulatory review and approval by NDEP and the Nevada State Engineer would be necessary prior to discharge.

2.3.1.6 Reclamation Alternatives. Various landforms created by the proposed mining project would remain following the completion of mining and processing operations. The following section discusses different techniques that could be used to reclaim project components.

Waste Rock Disposal Areas

- Natural Angle of Repose. In this alternative, the waste rock disposal area slopes would be left at the natural dump angle of repose of approximately 1.3:1, and the slopes would not be flattened. The benches and top of the disposal areas would be topsoiled and revegetated; the sides would not be reclaimed.

- Side Slopes Flattened to 3:1. Waste rock disposal area side slopes would be flattened from the natural angle of repose to an overall slope of approximately 3:1. The top, benches, and side slopes of the disposal areas would be topsoiled and revegetated.

- Insloping Waste Rock Area Benches. The proposed action is to retain benches across the faces of the waste rock which are slightly out-sloped to eliminate water ponding and infiltrating the waste rock mass. This alternative would retain benches with a slight slope inward toward the face of the slope. This alternative would increase moisture retention to facilitate revegetation and capture sediment generated by the slopes above the bench.

- Surface Contouring. These configurations could be used with any of the other reclamation alternatives.

- Existing Topography. The waste rock disposal areas would be aligned along existing topography to roughly blend the waste rock areas to the natural topography. The waste rock disturbance acreage would, therefore, be greater than for the proposed action because departing from the normal waste rock disposal would require more surface area.

- Hill Construction. A hill or series of small hills would be constructed during the last few weeks of waste rock disposal to provide a more natural look. This configuration would avoid leaving large, flat-topped waste rock disposal areas.

Tailings Impoundment

- Cover with Waste Rock. Under this alternative, waste rock would be dumped on top of the tailings impoundment in a selective manner to create an uneven surface of small hills and swales. The impoundment would then be topsoiled and revegetated.

Betze Pit

- Partial Backfill. Under this alternative, the Betze Pit would be partially backfilled with waste rock to the estimated post-mining water elevation. This would involve maintaining a haul truck fleet to load and carry waste rock back into the pit. Other transportation methods such as conveyors might also be used in the backfilling effort. It is estimated that partial backfilling would require over 2 years following the end of mining and cost approximately $197.2 million.

2.3.2 Alternatives Eliminated from Detailed Consideration

This section describes additional alternatives which were initially considered for analysis in the EIS but which were subsequently eliminated due to technical or economic infeasibility, the lack of environmental advantage over the proposed operation, or because they were not reasonably responsive to the purpose and needs of the project proponent. The range of reasonable project (as opposed to component) alternatives is more limited in the context of a mining operation than many other types of proposed actions because the location and ownership of the project proponent's ore deposit is fixed. For these reasons, alternatives such as mining a different deposit or in a different location or obtaining gold from different sources are not considered in detail.

In the case of an expansion of an existing mine and processing facility, the range of reasonable component alternatives are also limited to some extent by the location and character of existing development and facilities. For example, consideration of alternatives to the existing access or utility corridors is not considered in detail for this reason.

Certain other alternatives are not considered in detail because they were not considered responsive to the project proponent's needs and because the environmental impacts of such alternatives would be indistinguishable from either the proposed action or the no-action alternative. For example, patenting is a discretionary option open to a claimant with valid mining or millsite claims. The possible alternative of BLM issuing patents under the mining laws (and possibly eliminating the need for review under BLM's regulations) is not considered in detail because Barrick has advised BLM that it would expand the mine as proposed regardless of whether it were located on private or public land.

One alternative that was considered by BLM and eliminated from detailed treatment is the processing of part of Barrick's ore at existing Newmont facilities. This was considered unreasonable because neither Newmont nor Barrick have the excess capacity necessary to process one another's ore.

Another alternative that was considered by BLM but eliminated from detailed consideration is complete back-filling of the Betze Pit. This alternative would involve returning waste rock to the open pit to fill it to the approximate original surface. BLM considered the alternative unreasonable for several reasons. It is estimated that the equipment fleet

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of shovels, loaders, and trucks that was used for mining, and associated personnel, would have to work 24 hours per day, 365 days per year for approximately 6 years to load, haul, and dump the estimated 603.4 million tons of material back into the pit (the tailings from the milled ore would be unavailable). The cost of this operation alone would be approximately $290.4 million compared to a partial back-filling cost of $197.2 million.

During the time required to completely backfill the pit, reclamation of significant portions of the waste rock disposal areas would not proceed, and air quality, water quality, and other environmental impacts associated with loading, hauling, and dumping would continue. Finally, complete backfilling would seriously impair access to the Deep Post Deposit owned by Barrick and Newmont, which underlies the Betze Deposit. As noted below, development of the Deep Post Deposit is not presently proposed. Nevertheless, BLM believes it would be unreasonable to foreclose the possibility of mining the deposit by requiring complete backfilling of the Betze Pit.

A variant of backfilling considered by BLM but not addressed in detail in this EIS is complete backfilling with waste from another mining operation. Although such an alternative would likely be more cost-effective than returning waste to the pit from which it came, it would require the active mining of a pit in the near vicinity of the Betze Pit after operations at the latter have ceased. Whether such a pit would be in operation is speculative. In addition, this alternative would not address the concern of impairing access to the Deep Post Deposit previously described.

Barrick extensively considered the alternative of underground mining by block caving methods. This alternative was considered infeasible by Barrick for several reasons: first, the Betze Deposit largely lies beneath waste rock that is intermingled with oxide ore. Conceptually, the deeper ore could be mined by either underground or open-pit mining. Block caving is a method applicable to the bulk mining of ore deposits in weak rock. However, the Betze Deposit is highly fractured and may not permit underground mining, particularly in view of expected water inflows and potentially high temperatures. Block caving is highly productive, but grade control is difficult and dilution of the ore grade from the introduction of waste rock can be excessive. Control of the ore grade is considered by Barrick to be essential to a profitable operation at

of shovels, loaders, and trucks that was used for mining, and associated personnel; would have to work 24 hours per day, 365 days per year for approximately 4 years to load, haul, and dump the estimated 603.4 million tons of material back into the pit (the tailings from the milled ore would be unavailable). The cost of this operation alone would be approximately $298.4 million compared to a partial back-filling cost of $177.2 million.

During the time required to completely backfill the pit, reclamation of significant portions of the waste rock disposal areas would not proceed, and air quality, water quality, and other environmental impacts associated with loading, hauling, and dumping would continue. Finally, complete backfilling would seriously impair access to the Deep Post Deposit owned by Barrick and Newmont, which underlies the Betze Deposit. As noted below, development of the Deep Post Deposit is not presently proposed. Nevertheless, BLM believes it would be unreasonable to foreclose the possibility of mining the deposit by requiring complete backfilling of the Betze Pit.

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Goldstrike because dilution increases the milling expense and significantly increases the quantity of tailings that must be impounded. Barrick estimated the likely dilution of its ore grade at about 50 percent. In contrast, open-pit mining permits a high degree of grade control and reduces the volume of tailings produced. Second, underground mining would be inconsistent with the simultaneous development of the near-surface oxide reserves of the Upper Post and Betze deposits, requiring Barrick to either forgo mining of the surface deposits or delay the development work on an underground mine until surface mining and blasting was completed. This would effectively delay the recovery of commercial quantities of ore for several years beyond the completion of surface mining. Finally, underground mining presented safety and subsidence concerns not presented by surface mining. For these reasons, BLM eliminated the alternative of underground mining from detailed consideration.

Barrick also considered the alternative of expanding the Betze proposal to embrace concurrent mining of the Deep Post Deposit. Barrick considered this alternative to be presently infeasible, remote, and speculative because of several considerations: first, the Deep Post Deposit occurs at significant depth. It presents technical problems with respect to access, hydrology, temperature, rock stability, and mining methods. Extensive drilling, modeling, and engineering will be required to determine how the Deep Post Deposit can be most economically developed. Only the most preliminary work in that regard has been initiated by Barrick. Second, a substantial portion of the deposit is owned by Newmont, with whom Barrick has no agreement for such development. Newmont has indicated to Barrick and the public that it intends to concentrate its short-term development on oxide rather than sulfide ore. In the absence of an agreement with Newmont or a defined proposal to mine the Deep Post Deposit, Barrick has advised BLM that it cannot satisfy the enormous capital and other requirements for such development. Barrick also has advised BLM that it will be not less than 3 to 5 years before any proposal susceptible to meaningful environmental analysis is likely to be forthcoming, and it could be many years thereafter before such a proposal would be implemented.

Although development of the Deep Post Deposit is not presently proposed and will require additional environmental analysis if and when it is proposed, it is considered reasonably foreseeable by BLM. For this

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Although development of the Deep Post Deposit is not presently proposed and will require additional environmental analysis if and when it is proposed, it is considered reasonably foreseeable by BLM. For this

reason, it is discussed briefly in this EIS as an action that may ultimately be functionally connected to the proposed action and which may result in cumulative impacts with the proposed action.

2.3.3 No Action Alternative

For purposes of this EIS, the no-action alternative is characterized as BLM's disapproval of the proposed amendment to the Plan of Operations. The intent of the alternative is to illustrate the environmental consequences if the proposed or alternative expansion of Barrick's project does not occur. While the No Action alternative is characterized as disapproval of the proposed amendment, there may be other circumstances that effectively cause the same result. For example, if the application of some existing or future law or a precipitous drop in gold prices prevented Barrick from proceeding with all or part of its proposal, the environmental consequences may be substantially the same as if the amendment, or parts of it, were disapproved. Alternative circumstances under which the expansion may not proceed are not discussed in detail because of their similarity to the No Action alternative of disapproval.

BLM may be subject to certain limitations on its ability to select or implement the No Action alternative as it is described in this EIS. While BLM can condition its approval of the proposed on Barrick's acceptance of mitigation and reclamation measures that, in the discretion of BLM, are necessary to prevent unnecessary and undue degradation of public lands, BLM does not have the authority to categorically deny an amendment to a plan of operations that complies with the provisions of 40 CFR 3809. BLM recognizes that such limitations may not affect other variations on the No Action alternative. Consequently, the No Action alternative is fully evaluated in this EIS.

Barrick's proposed operations include some mining by Barrick for Newmont on lands owned by Newmont. If Barrick does not mine Newmont's land it is possible that Newmont may do so. In order to better illustrate the environmental consequences of Barrick's proposal, the No Action alternative assumes that such mining by Newmont will not occur on the adjacent Newmont land if it is not conducted as part of Barrick's proposal.

reason, it is discussed briefly in this EIS as an action that may ultimately be functionally connected to the proposed action and which may result in cumulative impacts with the proposed action.

2.3.3 No Action Alternative

For purposes of this EIS, the no-action alternative is characterized as BLM's disapproval of the proposed amendment to the Plan of Operations. The intent of the alternative is to illustrate the environmental consequences if the proposed or alternative expansion of Barrick's project does not occur. While the No Action alternative is characterized as disapproval of the proposed amendment, there may be other circumstances that effectively cause the same result. For example, if the application of some existing or future law or a precipitous drop in gold prices prevented Barrick from proceeding with all or part of its proposal, the environmental consequences may be substantially the same as if the amendment, or parts of it, were disapproved. Alternative circumstances under which the expansion may not proceed are not discussed in detail because of their similarity to the No Action alternative of disapproval.

BLM may be subject to certain limitations on its ability to select or implement the No Action alternative as it is described in this EIS. While BLM can condition its approval of the proposal on Barrick's acceptance of mitigation and reclamation measures that, in the discretion of BLM, are necessary to prevent unnecessary and undue degradation of public lands, BLM does not have the authority to categorically deny an amendment to a plan of operations that complies with the provisions of 43 CFR 3809. BLM recognizes that such limitations may not affect other variations on the No Action alternative. Consequently, the No Action alternative is fully evaluated in this EIS.

Barrick's proposed operations include some mining by Barrick for Newmont on lands owned by Newmont. If Barrick does not mine Newmont's land it is possible that Newmont may do so. In order to better illustrate the environmental consequences of Barrick's proposal, the No Action alternative assumes that such mining by Newmont will not occur on the adjacent Newmont land if it is not conducted as part of Barrick's proposal.

2.3.4 Preferred Alternative

NEPA regulations direct that BLM shall identify a preferred alternative. This may be done in the Draft EIS or in the Final EIS. In this instance BLM would prefer to have the benefit of a Draft EIS and public comments on the Draft EIS prior to identifying a preferred alternative. A preferred alternative will be identified in the Final EIS.

2.4 Summary Comparison of Impacts

A summary of the impacts associated with implementation of the proposed action or the alternatives is provided in Tables 2-10 through 2-16.

The table includes potential impacts for which additional evaluation is required before the impact can be quantified. Mitigation has been recommended for these potential impacts. They include:

- Geotechnical studies of tailings impoundment location prior to final design.
- Geotechnical studies of location for disposal of pit water by infiltration or reinjection.
- Continued cultural resource inventory and evaluation.

TABLE 2-10

SUMMARY OF PROPOSED ACTION

Resource/ Potential Impact	Recommended Mitigation	Overall Proposed Action	Major Proposed Components: Extended South Block Waste Rock Disposal	Proposed Sulfide Ore Stockpiles	Proposed Heap Leach Expansion	Proposed Tailings Impoundment	Proposed Water Pumping to Unnamed Draw	Proposed Reclamation	No Action
Geology, Minerals, and Seismicity									
Structural damage due to geologic hazards.	Site-specific geotechnical studies followed by proper design.	Potential structural impacts without proper design.	Low potential	No impacts.	No impacts.	Low potential during life of project.	NA	NA	No impacts.
Geologic hazard(s) created by project facility(s)	Geotechnical studies to determine site suitability.	Potential creation of geologic hazard(s) from unsuitable ground conditions.	Steep slopes may present unstable conditions during operations.	No impacts.	No impacts.	None expected.	No impacts.	NA	No impacts.
Air Resources									
Fugitive particulate matter (PM) emissions during construction and operation.	None recommended (controls included in proposed action).	Increased PM emissions.	Increased PM emissions.	—	—	—	—	—	Continued mining for 2 to 3 years. No additional impacts.
Water Resources									
Changes in surface water hydrology.	None recommended (erosion control plan included in proposed action).	Diversions around facilities and tailings impoundment; changes in stream flows.	Minor impacts.	No impacts.	Minor impacts.	Reduction in drainage areas (278 ac.)	Reduction in intermittant stream flow.	No impacts.	No new impact.
Accelerated erosion.	None recommended (erosion control plan included in proposed action).	Riprap channels, check dams and bank protection.	Potential for erosion from slopes prior to reclamation.	No impact.	No impact.	No impact.	Potential accelerated erosion in Unnamed Draw.	No impact.	No new impact.
Changes in water quality.	None recommended.	Treat discharge waters to meet NPDES requirements.	Low potential.	No impact.	No impact.	No impact.	Potential impacts if discharge not treated.	No impact.	No new impact.
Drawdown of groundwater levels.	Monitor local springs and seeps.	Dewater pit at rates up to 30,000 gpm and pit elevation of 4,160 ft.	NA	NA	NA	NA	Drawdown of 10 feet or more out to 6 miles.	NA	No new impacts.
Potential acid generation from waste rock.	Monitor water quality of runoff and any seepage.	Disposal site will cover all or portions of six drainage basins in the South Block. Sites will be covered with topsoil and reclaimed.	Low potential for seepage during wet periods.	Low potential.	NA	NA	NA	Reduction of impacts.	No new impacts.

TABLE 2-10 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Overall Proposed Action	Major Proposed Components						No Action
			Extended South Block Waste Rock Disposal	Proposed Sulfide Ore Stockpiles	Proposed Heap Leach Expansion	**Proposed Tailings Impoundment**	Proposed Water Pumping to Unnamed Draw	Proposed Reclamation	
Water Resources (continued)									
Potential cyanide impacts from tailings.	Monitor wildlife mortality.	Treat tailings with hydrogen peroxide, cover solution pond with netting.	NA	NA	Low potential.	**Low potential.**	NA	NA	No new impacts.
Water quality in pit after closure.	None recommended.	Expected drinking water quality except for arsenic.	NA	NA	NA	NA	NA	NA	Same as proposed action.
Soils and Reclamation									
Topsoil disturbance.	None recommended (topsoil salvage included in proposed action).	2,170 acres	1,150 acres	98 acres	165 acres	**375 acres**	NA	1,870 acres	No new impacts.
Potential for successful reclamation.	None recommended (reclamation included in proposed action).	1,870 acres	1,150 acres	98 acres	165 acres	**375 acres**	NA	1,870 acres	No new impacts.
Vegetation									
Temporary vegetation disturbance.	None recommended (reclamation included in proposed action).	1,870 acres	1,150 acres	98 acres	165 acres	**375 acres**	NA	1,870 acres	No new impacts.
Permanent vegetation loss (pit, mill site, etc.)	None available.	300 acres	NA	NA	NA	NA	NA	NA	No new impacts.
Wildlife									
Temporary removal of moderate to low quality wildlife habitat.	None recommended (reclamation included in proposed action).	1,870 acres	1,150 acres	98 acres	165 acres	**375 acres**	NA	1,870 acres	No new impacts.
Permanent removal of wildlife habitat.	None available.	300 acres	NA	NA	NA	NA	NA	NA	No new impacts.
Creation of barriers to migration routes.	None available.	No additional significant barriers to what now exist.	—	—	—	—	—	—	No new impacts.

TABLE 2-10 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Overall Proposed Action	Major Proposed Components: Extended South Block Waste Rock Disposal	Proposed Sulfide Ore Stockpiles	Proposed Heap Leach Expansion	Proposed Tailings Impoundment	Proposed Water Pumping to Unnamed Draw	Proposed Reclamation	No Action
Wildlife (continued)									
Impacts due to increased traffic, noise, and human presence.	None recommended (policy measures included in proposed action).	Slight increase in road kills, legal and illegal hunting, harassment, other disturbance.	—	—	—	—	—	—	No new impacts.
Disturbance of sage grouse habitat.	None recommended.	647 acres	NA	60 acres	165 acres	375 acres	NA	NA	No new impacts.
Disturbance of chuckar habitat.	None recommended.	0 acres	NA	NA	NA	NA	NA	NA	No new impacts.
Disturbance of Hungarian partridge habitat.	None recommended.	10 acres	10 acres	NA	NA	NA	NA	NA	No new impacts.
Disturbance to raptor nesting.	None recommended.	Reduction in red-tailed hawk foraging area.	Reduction in red-tailed hawk foraging area.	NA	NA	NA	NA	NA	No new impacts.
Impacts to aquatic biota due to increased sedimentation and loss of flow in Rodeo Creek.	None recommended (erosion control measures included in proposed action).	Loss of aquatic resources in Rodeo Creek, potential sedimentation impacts to Boulder Creek.	Sedimentation to Rodeo Creek/ Boulder Creek drainage.	NA	NA	Potential sedimentation to Brush Creek.	No impacts.	NA	No new impacts.
Recreation and Wilderness									
No impacts are anticipated.	None necessary.	No impacts are anticipated.	NA	NA	NA	NA	NA	NA	No new impacts.
Noise									
Exceedance of 65 dBA noise level at sensitive receptors.	None recommended.	No exceedance of noise standard off of site.	—	—	—	—	—	—	No new impacts.
Visual Resources									
Project would be consistent with VRM objectives.	Several alternatives comprise mitigation.	Consistent with VRM objectives.					—	—	No new impacts.

TABLE 2-10 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Overall Proposed Action	Major Proposed Components: Extended South Block Waste Rock Disposal	Proposed Sulfide Ore Stockpiles	Proposed Heap Leach Expansion	Proposed Tailings Impoundment	Proposed Water Pumping to Unnamed Draw	Proposed Reclamation	No Action
Cultural Resources									
Potential significant impacts to cultural resources.	Mitigation of significant resources in compliance with Section 106 of NHPA.	5 sites identified to date.	Affects 23 sites.	Affects 4 sites.	NA	Affects 22 sites.	NA	NA	No new impacts.
Land Use									
Temporary loss of grazing lands.	None recommended (reclamation included in proposed action).	479 AUMS	295 AUMs	25 AUMs	42 AUMs	96 AUMs	NA	479 AUMS	No new impacts.
Permanent loss of grazing (pit, mill site, etc.).	None available.	77 AUMs	NA	NA	NA	NA	NA	NA	No new impacts.
Socioeconomics									
Population increase in local communities.	None recommended.	Peak population increase of 301 people during construction; 225 during operations; 411 total peak during overlap in 1992.	—	—	—	—	—	—	Decline in current workforce.
Increased demand for housing.	Barrick continue to fund housing construction.	Need for 143 additional housing units during peak in 1992.	—	—	—	—	—	—	No new impacts.
Increased demand on schools and other public services and facilities.	Barrick continue to fund agencies and services.	Increase in demand for public services and facilities.	—	—	—	—	—	—	No new impacts.
Increased traffic on existing roads	Continue Barrick's use of buses for personnel.	Up to 38 additional vehicle trips per day on road north of Carlin.	—	—	—	—	—	—	No new impacts.
Negative fiscal impact to Elko County.	Negotiate up-front payment for critical items. Lobby for redistribution of sales tax revenues.	Infrastructure and service demand exceeding incremental county revenues.	—	—	—	—			
Increased tax revenue to Eureka County.	None recommended.	Increase in tax revenue.	—	—	—	—	—	—	No new impacts.

NA means the project component does not contribute to the potential impact.

— means the project component contributes to the impact only as an indirect element of the total project.

TABLE 2-11

COMPARISON OF HEAP LEACH OPTION WITH PROPOSED ACTION

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block-Central)	Heap Leach Western North Block
Geology, Minerals, and Seismicity			
Structural damage due to geologic hazards.	Site-specific geotechnical studies followed by proper design.	Potential structural impacts without proper design.	Same as proposed action.
Geologic hazard(s) created by project facility(s)	Geotechnical studies to determine site suitability.	Potential creation of geologic hazard(s) from unsuitable ground conditions.	Same as proposed action.
Air Resources			
Fugitive particulate matter (PM) emissions during construction and operation.	None recommended (controls included in proposed action).	Increased PM emissions.	Same as proposed action.
Water Resources			
Changes in surface water hydrology.	Implement erosion control plan, construct diversion berms and dikes.	Drainages in Rodeo, Bell, Brush, and Boulder Creeks will be altered. Rodeo Creek goes dry.	NA
Accelerated erosion.	Implement erosion control plan, construct diversion berms and dikes.	Erosion increase of over 3 tons/acre above native ground.	NA
Changes in water quality.	Implement spill control plan, maintain treatment plant for arsenic control.	None	NA
Drawdown of groundwater levels.	Water will return to basin via irrigation.	Dewater pit at rates up to 30,000 gpm and pit elevation of 4,160 feet.	NA
Potential acid generation from waste rock.	None recommended.	Exposure to sulfides, TDS, and arsenic prior to reclamation.	NA

TABLE 2-11 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block-Central)	Heap Leach Western North Block
Water Resources (continued)			
Potential cyanide impacts from tailings.	None recommended.	Runoff diverted and precipitation retained: minimum seepage.	NA
Water quality in pit after closure.	None recommended.	Similar to current groundwater: only arsenic would exceed drinking water levels.	NA
Soils and Reclamation			
Topsoil disturbance.	None recommended (topsoil salvage included in proposed action).	165 acres	Same as proposed action.
Potential for successful reclamation.	None recommended (reclamation included in proposed action).	165 acres	Same as proposed action.
Vegetation			
Temporary vegetation disturbance.	None recommended (reclamation included in proposed action).	165 acres	Same as proposed action.
Wildlife			
Temporary removal of wildlife habitat.	None recommended (reclamation included in proposed action).	165 acres	Same as proposed action.
Creation of barriers to migration routes.	None available.	No new barriers expected.	Same as proposed action.
Impacts due to increased traffic, noise, and human presence.	None recommended (policy measures included in proposed action).	Slight increase in road kills, legal and illegal hunting, harassment, other disturbance.	Same as proposed action.
Disturbance of sage grouse habitat.	None recommended.	165 acres	Same as proposed action.

TABLE 2-11 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block-Central)	Heap Leach Western North Block
Wildlife (continued)			
Disturbance of chukar habitat.	None recommended.	0 acres.	No impact.
Disturbance of Hungarian partridge habitat.	None recommended.	0 acres	50 acres.
Disturbance to raptor nesting.	None recommended.	Reduced hunting area for red-tailed hawk.	165 acres.
Impacts to aquatic biota due to increased sedimentation and loss of flow in Rodeo Creek.	None recommended erosion control measures in proposed action.	Loss of aquatic resources in Rodeo Creek, potential sedimentation in Boulder Creek.	NA
Recreation and Wilderness			
No impacts are anticipated.			
Noise			
Exceedance of 65 dBA noise level at sensitive receptors.	None recommended.	No exceedance of noise standard.	Same as proposed action.
Visual Resources			
Project would be consistent with VRM objectives.	Several alternatives comprise mitigation.	Consistent with VRM objectives.	No impact.
Cultural Resources			
Potential significant impacts to cultural resources.	Mitigation of significant resources in compliance with Section 106 of NHPA.	11 sites identified to date.	8 sites identified to date.

TABLE 2-11 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block-Central)	Heap Leach Western North Block
Land Use			
Temporary loss of grazing lands.	None recommended (reclamation included in proposed action).	479 AUMS	42 AUMS
Permanent loss of grazing.	None available.	77 AUMs	Same as proposed action.
Change in land use due to addition of new water body.	None recommended.	Creation of new 350-acre water body in abandoned pit.	NA
Socioeconomics			
Population increase in local communities.	None recommended.	Population increase of 225.	NA
Increased demand for housing.	Barrick continue to fund housing construction.	Need for 63 additional housing units.	NA
Increased demand on schools and other public services and facilities.	Barrick continue to fund agencies and services.	Increase in demand for public services and facilities.	NA
Increased traffic on existing roads	Continue Barrick's use of buses for personnel.	38 more vehicle trips per day on country road.	NA
Negative fiscal impact to Elko County.	Negotiate up-front payment for critical items. Lobby for redistribution of sales tax revenues.	Project will continue disproportionate revenues to Eureka County.	NA
Increased tax revenue to Eureka County.	None recommended.	Increase in tax revenue.	NA

TABLE 2-12

COMPARISON OF WASTE ROCK DISPOSAL OPTIONS WITH PROPOSED ACTION

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Extended South Block Waste Rock Disposal)	Waste Rock Disposal West Area[1]	North Area[1]	Clydesdales Area[1]	Far West Area
Geology, Minerals, and Seismicity						
Structural damage due to geologic hazards.	Site-specific geotechnical studies followed by proper design.	Potential structural impacts without proper design.	Same as proposed action.	Same as proposed action.	Lack of potentially expansive soils.	Same as proposed action.
Geologic hazard(s) created by project facility(s)	Geotechnical studies to determine site suitability.	Potential creation of geologic hazard(s) from unsuitable ground conditions.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Air Resources						
Fugitive particulate matter (PM) emissions during construction and operation.	None recommended (controls included in proposed action).	Increased PM emissions.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Water Resources						
Changes in surface water hydrology.	Implement erosion control plan, construct diversion berms and dikes.	Will alter flows and drainages in Rodeo, Brush, and Boulder Creeks.	Same as proposed action.	Same as proposed action.	Would bury a spring.	Would relocate Unnamed Draw channel.
Accelerated erosion.	Implement erosion control plan, construct diversion berms and dikes.	Erosion increase of over 3 tons/acre more than native ground.	Same as proposed action.	Same as proposed action.	May increase sedimentation to Bell Creek.	Increased erosion in Unnamed Draw.
Changes in water quality.	Implement spill control plan, maintain water treatment plant for arsenic control.	NA to waste rock disposal options	NA	NA	NA	NA
Drawdown of groundwater levels.	Water will return to basin through irrigation.	NA	NA	NA	NA	NA
Potential acid generation from waste rock.	None recommended.	Potential exposure of sulfate, TDS, and arsenic prior to reclamation.	Same as proposed action.	Same as proposed action.	Increased potential for contamination.	Same as proposed action.
Potential cyanide impacts from tailings.	None recommended.	NA	NA	NA	NA	NA

TABLE 2-12 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Extended South Block Waste Rock Disposal)	Waste Rock Disposal West Area[1]	North Area[1]	Clydesdales Area[1]	Far West Area
Water Resources (continued)						
Water quality in pit after closure.	None recommended.	NA	NA	NA	NA	NA
Soils and Reclamation						
Topsoil disturbance.	None recommended (topsoil salvage included in proposed action).	1,150 acres	810 acres	450 acres	670 acres	2,050 acres
Potential for successful reclamation.	None recommended (reclamation included in proposed action).	1,150 acres	810 acres	450 acres	670 acres	2,050 acres
Vegetation						
Temporary vegetation disturbance.	None recommended (reclamation included in proposed action).	1,150 acres	810 acres	450 acres	670 acres	2,050 acres
Wildlife						
Temporary removal of moderate to low quality wildlife habitat.	None recommended (reclamation included in proposed action).	1,150 acres	810 acres	450 acres	670 acres	2,050 acres
Creation of barriers to migration routes.	None available.	No additional significant barriers to what now exist.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Impacts due to increased traffic, noise, and human presence.	None recommended (policy measures included in proposed action).	Slight increase in road kills, legal and illegal hunting, harassment, and other disturbance.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Disturbance of sage grouse habitat.	None recommended.	0 acres	Similar to proposed action.	Similar to proposed action.	Similar to proposed action.	Similar to proposed action.
Disturbance of chuckar habitat.	None recommended.	0 acres	Similar to proposed action.	Similar to proposed action.	50 acres.	Similar to proposed action.

TABLE 2-12 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Extended South Block Waste Rock Disposal)	Waste Rock Disposal West Area[1]	North Area[1]	Clydesdales Area[1]	Far West Area
<u>Wildlife (continued)</u>						
Disturbance of Hungarian partridge habitat.	None recommended.	10 acres	Same as proposed proposed.	No impact.	No impact.	Same as proposed action.
Disturbance to raptor nesting.	None recommended.	Reduction in red-tailed hawk hunting area.	Less impact than proposed action.	Similar to proposed action.	No impact.	Similar to proposed action.
Impacts to aquatic biota due to increased sedimentation and loss of flow in Rodeo Creek.	None recommended (erosion control measures included in proposed action).	Sedimentation to Rodeo Creek/Boulder Creek drainage.	Same as proposed action.	Same as proposed action.	Potential sedimentation to Bell Creek.	Similar to proposed action.
<u>Recreation and Wilderness</u>						
No impacts are anticipated.						
<u>Noise</u>						
Exceedance of 65 dBA noise level at sensitive receptors.	None recommended.	No exceedance of noise standard.	Same as proposed action.	Same as proposed action.	Possible exceedance of noise standard at line shack.	Same as proposed action.
<u>Visual Resources</u>						
Project would be consistent with VRM objectives.	Several alternatives comprise mitigation.	Consistent with VRM objectives.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
<u>Cultural Resources</u>						
Potential significant impacts to cultural resources.	Mitigation of significant resources in compliance with Section 106 of NHPA.	23 sites identified to date.	?	11 sites identified to date.	11 sites identified to date.	23 sites identified to date.

TABLE 2-12 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Extended South Block Waste Rock Disposal)	Waste Rock Disposal: West Area[1]	Waste Rock Disposal: North Area[1]	Waste Rock Disposal: Clydesdales Area[1]	Waste Rock Disposal: Far West Area
<u>Land Use</u>						
Temporary loss of grazing lands.	None recommended (reclamation included in proposed action).	479 AUMS	208 AUMs	115 AUMs	172 AUMs	526 AUMs
<u>Socioeconomics</u>						
Population increase in local communities.	None recommended.	NA to waste rock disposal options.	NA	NA	NA	NA
Increased demand for housing.	Barrick continue to fund housing construction.	NA	NA	NA	NA	NA
Increased demand on schools and other public services and facilities.	Barrick continue to fund agencies and services.	NA	NA	NA	NA	NA
Increased traffic on existing roads	Continue Barrick's use of buses for personnel.	NA	NA	NA	NA	NA
Negative fiscal impact to Elko County.	Negotiate up-front payment for critical items. Lobby for redistribution of sales tax revenues.	NA	NA	NA	NA	NA
Increased tax revenue to Eureka County.	None recommended.	NA	NA	NA	NA	NA

[1]Two or more of these areas would be required to contain the projected volume of waste rock.

TABLE 2-13

COMPARISON OF SULFIDE ORE STOCKPILE OPTIONS WITH PROPOSED ACTION

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block and AA Block)	Sulfide Ore Stockpiles: South Block Waste Rock Area	Sulfide Ore Stockpiles: AA Block Leach Pads	Sulfide Ore Stockpiles: South Block Rodeo Creek
<u>Geology, Minerals, and Seismicity</u>					
Structural damage due to geologic hazards.	Site-specific geotechnical studies followed by proper design.	Potential structural impacts without proper design.	NA	NA	NA
Geologic hazard(s) created by project facility(s)	Geotechnical studies to determine site suitability.	Potential creation of geologic hazard(s) from unsuitable ground conditions.	NA	NA	NA
<u>Air Resources</u>					
Fugitive particulate matter (PM) emissions during construction and operation.	None recommended (controls included in proposed action).	Increased PM emissions.	Same as proposed action.	Same as proposed action.	Same as proposed action.
<u>Water Resources</u>					
Changes in surface water hydrology.	Implement erosion control plan, construct diversion berms and dikes.	NA	NA	NA	NA
Accelerated erosion.	Implement erosion control plan, construct diversion berms and dikes.	NA	NA	NA	NA
Changes in water quality.	Implement spill control plan, maintain treatment plant for arsenic control.	NA	NA	NA	NA
Drawdown of groundwater levels.	Water will return to basin via irrigation.	NA	NA	NA	NA
Potential acid generation from waste rock.	None recommended.	NA	NA	NA	NA
Potential cyanide impacts from tailings.	None recommended.	NA	NA	NA	NA

TABLE 2-13 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block and AA Block)	Sulfide Ore Stockpiles South Block Waste Rock Area	Sulfide Ore Stockpiles AA Block Leach Pads	Sulfide Ore Stockpiles South Block Rodeo Creek
Water Resources (continued)					
Water quality in pit after closure.	None recommended.	NA	NA	NA	NA
Soils and Reclamation					
Topsoil disturbance.	None recommended (topsoil salvage included in proposed action).	98 acres	No impact.	No impact.	No impact.
Potential for successful reclamation.	None recommended (reclamation included in proposed action).	98 acres	Same as proposed action.	Same as proposed action.	Same as proposed action.
Vegetation					
Temporary vegetation disturbance.	None recommended (reclamation included in proposed action).	98 acres	No impact.	No impact.	No impact.
Wildlife					
Temporary removal of wildlife habitat.	None recommended (reclamation included in proposed action).	98 acres	No impact.	No impact.	No impact.
Creation of barriers to migration routes.	None available.	No barriers created.	No impact.	No impact.	No impact.
Impacts due to increased traffic, noise, and human presence.	None recommended (policy measures included in proposed action).	Slight increase in road kills, legal and illegal hunting, harassment, and other disturbance.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Disturbance of sage grouse habitat.	None recommended.	98 acres	No impact.	No impact.	No impact.
Disturbance of chukar habitat.	None recommended.	0 acres	No impact.	No impact.	No impact.
Disturbance of Hungarian partridge habitat.	None recommended.	0 acres	No impact.	No impact.	No impact.

TABLE 2-13 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block and AA Block)	Sulfide Ore Stockpiles		
			South Block Waste Rock Area	AA Block Leach Pads	South Block Rodeo Creek
Wildlife (continued)					
Disturbance of raptor nesting.	None recommended	Reduced hunting area for red-tailed hawk.	No impact.	No impact.	No impact.
Impacts to aquatic biota due to increased sedimentation and loss of flow in Rodeo Creek.	None recommended. Erosion control plan part of proposed action.	No impacts expected.	No impact.	No impact.	No impact.
Recreation and Wilderness					
No impacts are anticipated.					
Noise					
Exceedance of 65 dBA noise level at sensitive receptors.	None recommended.	No exceedance of noise standard.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Visual Resources					
Project would be consistent with VRM objectives.	Several alternatives comprise mitigation.	Consistent with VRM objectives.	No impact.	No impact.	No impact.
Cultural Resources					
Potential significant impacts to cultural resources.	Mitigation of significant resources in compliance with Section 106 of NHPA.	4 sites identified to date.	No impact.	No impact.	No impact.
Land Use					
Temporary loss of grazing lands.	None recommended (reclamation included in proposed action).	637 AUMs	No impact.	No impact.	No impact.
Change in land use due to addition to new water body.	None recommended.	Creation of new 350-acre water body in abandoned pit.	Same as proposed action.	Same as proposed action.	Same as proposed action.

TABLE 2-13 (CONTINUED)

Resource, Potential Impact	Recommended Mitigation	Proposed Action (North Block and AA Block)	Sulfide Ore Stockpiles: South Block Waste Rock Area	Sulfide Ore Stockpiles: AA Block Leach Pads	Sulfide Ore Stockpiles: South Block Rodeo Creek
<u>Socioeconomics</u>					
Population increase in local communities.	None recommended.	Population increase of 225.	NA	NA	NA
Increased demand for housing.	Barrick continue to fund housing construction.	Need for 63 additional housing units.	NA	NA	NA
Increased demand on schools and other public services and facilities.	Barrick continue to fund agencies and services.	Increase in demand for public services and facilities.	NA	NA	NA
Increased traffic on existing roads	Continue Barrick's use of buses for personnel.	38 more vehicle trips/ day in county road.	NA	NA	NA
Negative fiscal impact to Elko County.	Negotiate up-front payment for critical items. Lobby for redistribution of sales tax revenues.	Project will continue disproportionate revenues to Eureka County.	NA	NA	NA
Increased tax revenue to Eureka County.	None recommended.	Increase in tax revenue.	NA	NA	NA

TABLE 2-14

COMPARISON OF TAILING DISPOSAL OPTIONS WITH PROPOSED ACTION

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block - East)	Tailings Disposal: North Block Expanded East Area	Tailings Disposal: North Block Central Area	Tailings Disposal: Capacity Adjustment
Geology, Minerals, and Seismicity					
Structural damage due to geologic hazards.	Site-specific geotechnical studies followed by proper design.	Potential structural impacts without proper design.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Geologic hazard(s) created by project facility(s)	Geotechnical studies to determine site suitability.	Potential creation of geologic hazard(s) from unsuitable ground conditions. 225-foot high embankment.	300-foot high embankment.	150-foot high embankment.	?
Air Resources					
Fugitive particulate matter (PM) emissions during construction and operation.	None recommended (controls included in proposed action).	NA	NA	NA	NA
Water Resources					
Changes in surface water hydrology.	Implement erosion control plan, construct diversion berms and dikes.	Drainages in Rodeo and Bell Creeks will be altered. Rodeo Creek goes dry.	Same as proposed action.	Same as proposed action.	?
Accelerated erosion.	Implement erosion control plan, connstruct diversion berms and dikes.	NA	NA	NA	NA
Changes in water quality.	Seepage collection system on embankment and lined pipeline ditch will prevent tailings discharges.	Tailings spills could degrade water quality.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Drawdown of groundwater levels.	Water will return to basin via irrigation.	NA	NA	NA	NA
Potential acid generation from waste rock.	None recommended.	NA	NA	NA	NA

TABLE 2-14 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block - East)	Tailings Disposal North Block Expanded East Area	Tailings Disposal North Block Central Area	Tailings Disposal Capacity Adjustment
Water Resources (continued)					
Potential cyanide impacts from tailings.	None recommended.	Seepage from tailings or embankment failure could degrade water quality.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Water quality in pit after closure.	None recommended.	NA	NA	NA	NA
Soils and Reclamation					
Topsoil disturbance.	None recommended (topsoil salvage included in proposed action).	375 acres	645 acres	575 acres	200 acres approximately.
Potential for successful reclamation.	None recommended (reclamation included in proposed action).	375 acres	645 acres	575 acres	200 acres approximately.
Vegetation					
Temporary vegetation disturbance.	None recommended (reclamation included in proposed action).	375 acres	645 acres	575 acres	200 acres approximately.
Wildlife					
Temporary removal of wildlife habitat.	None recommended (reclamation included in proposed action).	375 acres	645 acres	575 acres	200 acres approximately.
Creation of barriers to migration routes.	None available.	No new barriers expected to be created.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Impacts due to increased traffic, noise, and human presence.	None recommended (policy measures included in proposed action).	Slightly increase in road kills, legal and illegal hunting, harassment, and other disturbance.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Disturbance of sage grouse habitat.	None recommended.	375 acres	495 acres	0 acres	? acres

TABLE 2-14 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block - East)	Tailings Disposal North Block Expanded East Area	Tailings Disposal North Block Central Area	Tailings Disposal Capacity Adjustment
Wildlife (continued)					
Disturbance of Hungarian partridge habitat.	None recommended.	0 acres	0 acres	0 acres	0 acres
Disturbance to raptor nesting.	None recommended	Reduction in red-tailed hawk hunting area.	NA	NA	NA
Impacts to aquatic biota due to increased sedimentation and loss of flow in Rodeo Creek.	None recommended.	Increase in sedimentation of 3 tons/ac. Will eliminate flows in Rodeo Creek.	NA	NA	NA
Recreation and Wilderness					
No impacts are anticipated.					
Noise					
Exceedance of 65 dBA noise level at sensitive receptors.	None recommended.	No exceedance of noise standard.	NA	NA	NA
Visual Resources					
Project would be consistent with VRM objectives.	Several alternatives comprise mitigation.	Consistent with VRM objectives.	Same as proposed	Less visual impact than proposed action.	Same as proposed
Cultural Resources					
Potential significant impacts to cultural objectives.	Mitigation of significant resources in compliance with Section 106 of NHPA.	22 sites identified to date.	21 sites identified to date.	11 sites identified to date.	? sites identified to date.
Land Use					
Temporary loss of grazing lands.	None recommended (reclamation included in proposed action).	155 AUMS	165 AUMs	147 AUMs	51 AUMs

TABLE 2-14 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (North Block - East)	Tailings Disposal: North Block Expanded East Area	Tailings Disposal: North Block Central Area	Tailings Disposal: Capacity Adjustment
Land Use (continued)					
Change in land use due to addition to new water body.	None recommended.	NA	NA	NA	NA
Socioeconomics					
Population increase in local communities.	None recommended.	NA	NA	NA	NA
Increased demand for housing.	Barrick continue to fund housing construction.	NA	NA	NA	NA
Increased demand on schools and other public services and facilities.	Barrick continue to fund agencies and services.	NA	NA	NA	NA
Increased traffic on existing roads	Continue Barrick's use of buses for personnel.	NA	NA	NA	NA
Negative fiscal impact to Elko County.	Negotiate up-front payment for critical items. Lobby for redistribution of sales tax revenues.	NA	NA	NA	NA
Increased tax revenue to Eureka County.	None recommended.	NA	NA	NA	NA

TABLE 2-15

COMPARISON OF RECLAMATION OPTIONS WITH PROPOSED ACTION

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (2.5:1 Slopes, Topsoil Sites)	Waste Rock 1.3:1 Slopes	Waste Rock 3:1 Slopes	Waste Rock Insloping Benches	Waste Rock Existing Topography	Waste Rock Hill Construction	Tailings - Waste Rock Cover	Betze Pit - Partial Backfill
Geology, Minerals, and Seismicity									
Structural damage due to geologic hazards.	Site-specific geotechnical studies followed by proper design.	Potential structural impacts without proper design.	Potential for waste rock slope failures.	Same as proposed action.	Reduces erosion from but increases infiltration into waste rock.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Geologic hazard(s) created by project facility(s)	Geotechnical studies to determine site suitability.	Potential creation of geologic hazard(s) from unsuitable ground conditions.	NA	NA	NA	NA	NA	NA	Decreased potential for waste rock pile slope failures.
Air Resources									
Fugitive particulate matter (PM) emissions during construction and operation.	None recommended (controls included in proposed action).	Increased PM emissions.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Postponement of reclamation for 6 years during pit backfill
Water Resources									
Changes in surface water hydrology.	Reclamation will reduce erosion potential to near original conditions.	Slopes of 2.5:1, all facilities topsoiled.	Same as proposed action.	Same as proposed action.	Slight decrease in runoff from waste rock.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Accelerated erosion.	Implement Barrick's existing erosion control plan.	Land disturbance of 2,170 acres, 4.559 tons per acre erosion.	4.804 tons per acre prior to reclamation.	3.669 tons per acre prior to reclamation.	Slight decrease in runoff from waste rock.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Changes in water quality.	Implement spill control plan, maintain treatment plant for arsenic.	None	Slight increase in TDS.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Drawdown of groundwater levels.	Water will return to basin via irrigtion.	Drawdown of 10 feet or more out to 6 miles.	NA	NA	NA	NA	NA	NA	Will slow the rate of recovery of drawdown.
Potential acid generation from waste rock.	None recommended.	Exposure to sulfates, TDS, and arsenic prior to reclamation.	Least contact time.	Same as proposed action.	Greatest contact time.	NA	NA	NA	NA

TABLE 2-15 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (2.5:1 Slopes, Topsoil Sites)	Waste Rock 1.3:1 Slopes	Waste Rock 3:1 Slopes	Waste Rock Insloping Benches	Waste Rock Existing Topography	Waste Rock Hill Construction	Tailings - Waste Rock Cover	Betze Pit - Partial Backfill
Water Resources (continued)									
Potential cyanide impacts from tailings.	None recommended.	Runoff diverted and precipitation retained. Seepage collected and pumped back.	NA	NA	NA	Same as proposed action.	Same as proposed action.	Same as proposed action.	NA
Water quality in pit after closure.	None recommended.	Similar to current ground-water only arsenic would exceed drinking water levels.	NA	NA	NA	NA	NA	NA	No water body inpit.
Soils and Reclamation									
Topsoil disturbance.	None recommended (top-soil salvage included in proposed action).	2,170 acres	Less soil distur-bance than proposed action	More soil distur-bance than proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Potential for success-ful reclamation.	None recommended (reclamation included in proposed action).	Adequate slope stability and revegetation.	Increased poten-tial for slope instability and erosion, less potential for reclamation.	Same as proposed action.	Slightly increased potential for successful revege-tation.	Same as proposed action.	Same as proposed action.	Lower potential for revegetation.	350 additional acres to be revegetated.
Vegetation									
Temporary vegetation disturbance.	None recommended (reclamation included in proposed action).	2,170 acres	Less vegetation disturbance than proposed action.	More vegetation disturbance than proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Postponement of revegetation on waste rock piles for 6 additional years.
Wildlife									
Temporary removal of wildlife habitat.	None recommended (reclamation included in proposed action).	2,170 acres	Less area of dis-turbance than proposed action.	More area of dis-turbance than proposed action.	Slightly increased potential for suc-cessful reclamation.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Continuation of habitat disturbance on waste rock piles for 6 additional years.
Creation of barriers to migration routes.	None available.	No additional barriers expected.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as propsoed action.	Same as proposed action.	Same as proposed action.
Impacts due to increased traffic, noise, and human presence.	None recommended (policy measures included in proposed action).	Slight increase in road kills, legal and illegal hunting, harassment, and other disturbance.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Continuation of increased activity for 6 additional years.

TABLE 2-15 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (2.5:1 Slopes, Topsoil Sites)	Waste Rock 1.3:1 Slopes	Waste Rock 3:1 Slopes	Waste Rock Insloping Benches	Waste Rock Existing Topography	Waste Rock Hill Construction	Tailings - Waste Rock Cover	Betze Pit - Partial Backfill
Wildlife (continued)									
Disturbance of sage grouse habitat.	None recommended.	575 acres	Less area of disturbance than proposed action.	More area of disturbance than proposed action.	NA	NA	NA	NA	Same as proposed action.
Disturbance of Hungarian partridge habitat.	None recommended.	0 acres	NA	NA	NA	NA	NA	NA	NA
Impacts to aquatic biota due to increased sedimentation and loss of flow in Rodeo Creek.	None recommended.	Increase in sedimentation of 3 tons/ac. Will eliminate flow in Rodeo Creek.	Greater erosion potential than proposed action.	Less erosion potential than proposed action.	Less erosion potential than proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Recreation and Wilderness									
No impacts are anticipated.									
Noise									
Exceedance of 65 dBA noise level at sensitive receptors.	None recommended.	No exceedance of noise standard.	NA	NA	NA	NA	NA	NA	Noise generation would continue for 6 additional years.
Visual Resources									
Project would be consistent with VRM objectives.	Several alternatives comprise mitigation.	Consistent with VRM objectives.	Greater visual impact of waste rock piles.	Slightly less visual impact than proposed action.	Same as proposed action.	Less visual impact than proposed action.	Less visual impact than proposed action.	NA	Reduction in long-term visual impact of waste rock piles.
Cultural Resources									
Potential significant impacts to cultural resources.	Mitigation of significant resources in compliance with Section 106 of NHPA.	262 sites identified to date.	Less disturbance than proposed action.	More disturbance than proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Land Use									
Temporary loss of grazing lands.	None recommended (reclamation included in proposed action).	637 AUMS	Less disturbance than proposed action.	More disturbance than proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.

TABLE 2-15 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (2.5:1 Slopes, Topsoil Sites)	Waste Rock 1.3:1 Slopes	Waste Rock 3:1 Slopes	Waste Rock Insloping Benches	Waste Rock Existing Topography	Waste Rock Hill Construction	Tailings - Waste Rock Cover	Betze Pit - Partial Backfill
Land Use (continued)									
Change in land use due to addition to new water body.	None recommended.	Creation of new 350-acre water body in abandoned pit.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	Same as proposed action.	No open water in pit following closure.
Socioeconomics									
Population increase in local communities.	None recommended.	NA	NA	NA	NA	NA	NA	NA	NA
Increased demand for housing.	Barrick continue to fund housing construction.	NA	NA	NA	NA	NA	NA	NA	NA
Increased demand on schools and other public services and facilities.	Barrick continue to fund agencies and services.	NA	NA	NA	NA	NA	NA	NA	NA
Increased traffic on existing roads	Continue Barrick's use of buses for personnel.	NA	NA	NA	NA	NA	NA	NA	Will extend traffic effects 6 additional years.
Negative fiscal impact to Elko County.	Negotiate up-front payment for critical items. Lobby for redistribution of sales tax revenues.	NA	NA	NA	NA		NA	NA	Will extend revenue situation 6 additional years.
Increased tax revenue to Eureka County.	None recommended.	NA	NA	NA	NA		NA	NA	Will extend revenue situation 6 additional years.

TABLE 2-16

COMPARISON OF WATER HANDLING AND DISPOSAL OPTIONS WITH PROPOSED ACTION

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Discharge to TS Ranch Reservoir)	Water Handling and Disposal		
			Infiltration	Reinjection	Discharge to Rodeo or Boulder Creek
Geology, Minerals, and Seismicity					
Structural damage due to geologic hazards.	Site-specific geotechnical studies followed by proper design.	Potential structural impacts without proper design.	NA	NA	NA
Geologic hazard(s) created by project facility(s)	Geotechnical studies to determine site suitability.	Potential creation of geologic hazard(s) from unsuitable ground conditions.	NA	NA	NA
Air Resources					
Fugitive particulate matter (PM) emissions during construction and operation.	None recommended (controls included in proposed action).	NA	NA	NA	NA
Water Resources					
Changes in surface water hydrology.	Implement erosion control plan, construct diversion berms and dikes.	Discharge up to 30,000 gpm to Unnamed Draw and TS Ranch reservoir. Water balance maintained in basin.	Similar land application but not for irrigation, reduced erosion.	No benefit derived except maintain water balance in basin.	Change low flow intermittant stream to hi-flow, perennial stream.
Accelerated erosion.	Implement erosion control plan, construct diversion berms and dikes.	Discharge up to 30,000 gpm to Unnamed Draw and TS Ranch reservoir. Water balance maintained in basin.	Less potential erosion.	Reduced erosion.	Increased channel erosion.
Changes in water quality.	Implement spill control plan, maintain treatment plant for arsenic.	None	NA	NA	NA
Drawdown of groundwater levels.	Water will return to basin via irrigation.	Drawdown of over 10 feet out to 6 miles.	Increased evaporative losses.	Increased spring and well yield.	Same as proposed action.
Potential acid generation from waste rock.	None recommended.	NA	NA	NA	NA

TABLE 2-16 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Discharge to TS Ranch Reservoir)	Water Handling and Disposal		
			Infiltration	Reinjection	Discharge to Rodeo or Boulder Creek
Water Resources (continued)					
Potential cyanide impacts from tailings.	None recommended.	NA	NA	NA	NA
Water quality in pit after closure.	None recommended.	Similar to current groundwater, only arsenic would exceed drinking water levels.	NA	NA	NA
Soils and Reclamation					
Topsoil disturbance.	None recommended (topsoil salvage included in proposed action).	590 acres at reservoir.	Acreage not yet determined.	Acreage not yet determined.	No impact.
Potential for successful reclamation.	None recommended (reclamation included in proposed action).	Adequate slope stability and revegetation.	NA	NA	NA
Vegetation					
Temporary vegetation disturbance.	None recommended (reclamation included in proposed action).	590 acres at reservoir.	Location and acreage not yet determined.	Location and acreage not yet determined.	No impact.
Wildlife					
Temporary removal of wildlife habitat.	None recommended (reclamation included in proposed action).	590 acres	Location and acreage not yet determined.	Location and acreage not yet determined.	No impact.
Creation of barriers to migration routes.	None available.	Unnamed Draw may be a barrier at times.	No impact.	No impact.	Same as proposed action.
Impacts due to increased traffic, noise, and human presence.	None recommended (policy measures included in proposed action).	No impact.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Disturbance of sage grouse habitat.	None recommended.	Grouse habitat at reservoir unknown.	Location and acreage not yet determined.	Location and acreage not yet determined.	NA

TABLE 2-16 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Discharge to TS Ranch Reservoir)	Water Handling and Disposal		
			Infiltration	Reinjection	Discharge to Rodeo or Boulder Creek
Wildlife (continued)					
Disturbance of Hungarian partridge habitat.	None recommended.	0 acres	Same as proposed action.	Same as proposed action.	Same as proposed. action.
Impacts to aquatic biota due to increased sedimentation and loss of flow in Rodeo Creek.	Erosion control plan part of proposed action.	Rodeo Creek will dry out and aquatic biota will be lost.	No impact.	No impact.	Increased, permanent flow conditions may stress aquatic biota.
Recreation and Wilderness					
No impacts are anticipated.					
Noise					
Exceedance of 65 dBA noise level at sensitive receptors.	None recommended.	No exceedance of noise standard.	NA	Pump station may have noise effects.	NA
Visual Resources					
Project would be consistent with VRM objectives.	Several alternatives comprise mitigation.	Consistent with VRM objectives.	Same as proposed action.	Same as proposed action.	Same as proposed action.
Cultural Resources					
Potential significant impacts to cultural resources.	Mitigation of significant resources in compliance with Section 106 of NHPA.	? sites identified to date.	Location not yet determined.	Location not yet determined.	No impact.
Land Use					
Temporary loss of grazing lands.	None recommended (reclamation included in proposed action).	151 AUMs	Location and acreage not yet determined.	Location and acreage not yet determined.	No impact.
Change in land use due to addition to new water body.	None recommended.	Creation of new 350-acre water body in abandoned pit.	NA	NA	NA

TABLE 2-16 (CONTINUED)

Resource/ Potential Impact	Recommended Mitigation	Proposed Action (Discharge to TS Ranch Reservoir)	Water Handling and Disposal		
			Infiltration	Reinjection	Discharge to Rodeo or Boulder Creek
Socioeconomics					
Population increase in local communities.	None recommended.	NA	NA	NA	NA
Increased demand for housing.	Barrick continue to fund housing construction.	NA	NA	NA	NA
Increased demand on schools and other public services and facilities.	Barrick continue to fund agencies and services.	NA	NA	NA	NA
Increased traffic on existing roads	Continue Barrick's use of buses for personnel.	NA	NA	NA	NA
Negative fiscal impact to Elko County.	Negotiate up-front payment for critical items. Lobby for redistribution of sales tax revenues.	NA	NA	NA	NA
Increased tax revenue to Eureka County.	None recommended.	NA	NA	NA	NA

3.0 AFFECTED ENVIRONMENT

Chapter 3.0 describes the environment that would be affected by development of the Betze Project. Information summarized in this chapter was obtained from published sources; unpublished materials from interviews with local, state, and federal agencies; and reconnaissance surveys of the project site. The study area varies with different resources. For some resources such as vegetation and soils, the affected area was confined to the physical location and immediate vicinity of the mine site and the ancillary facilities. For other resources, such as air resources and socioeconomics, a regional study area was delineated, and the affected environment was considered in a regional context.

3.1 Topography and Physiography

The terrain at the Betze Project is typical of the Basin and Range physiographic province; it is dominated by north-trending fault-block mountain ranges which expose sedimentary rocks of the Paleozoic Age. The Betze Project is sited in the Little Boulder Basin, which contains the drainages of Brush, Rodeo, and Bell creeks. These drainages converge with Boulder Creek in northern Boulder Valley west of the project area. The project area is located in hills on the western edge of the basin. These hills consist of several north-oriented ridges. Elevations range from 5,100 feet above mean sea level (AMSL) in the foothills of Boulder Valley to 5,926 feet AMSL in the highest portion of the South Block. Little Boulder Basin is surrounded by 6,000- to 7,500-feet topography of the Tuscarora Mountains, a small north-trending range. The existing mining operation has affected the local topography.

3.2 Geology, Mineral Resources, and Paleontology

3.2.1 Geologic Setting

The project site is located at the extreme northern edge of Boulder Valley, immediately south of Little Boulder Basin and Rodeo Creek, on the west side of the Tuscarora Mountains in the northern part of the Lynn Mining District. The site is bounded by north-trending, fault blocks

3.0 AFFECTED ENVIRONMENT

Chapter 3.0 describes the environment that would be affected by development of the Santa Project. Information summarized in this chapter was obtained from published sources; unpublished materials from interviews with local, state, and federal agencies; and reconnaissance surveys of the project site. The study area varies with different resources. For some resources such as vegetation and soils, the affected area was confined to the proposed location and immediate vicinity of the mine site and the ancillary facilities. For other resources, such as air resources and socioeconomics, a regional study area was delineated, and the affected environment was considered in a regional context.

3.1 Topography and Physiography

The terrain at the Santa Project is typical of the Basin and Range physiographic province; it is dominated by north-trending fault-block mountain ranges which expose sedimentary rocks of the Paleozoic Age. The Santa Project is sited in the Little Boulder Basin, which contains the drainages of Brush, Rodeo, and Bell creeks. These drainages converge with Boulder Creek in northern Boulder Valley west of the project area. The project area is located in hills on the western edge of the basin. These hills consist of several north-oriented ridges. Elevations range from 4,400 feet above mean sea level (AMSL) in the foothills of Boulder Valley to 7,328 feet AMSL in the highest portion of the Santa Block. Little Boulder Basin is surrounded by 6,000- to 7,500-feet topography of the Tuscarora Mountains, a small north-trending range. The existing mining operation has affected the local topography.

3.2 Geology, Mineral Resources, and Paleontology

3.2.1 Regional Setting

The project site is located at the extreme northern edge of Boulder Valley, immediately south of Little Boulder Basin and Brush Creek, on the west side of the Tuscarora Mountains in the northern part of the Lynn Mining District. The site is bounded by north-trending, fault blocks

exposing sedimentary rocks of the physiographic province. The geologic setting is composed of Lower Paleozoic marine sediments, a Jurassic-Cretaceous intrusive, and Late Tertiary tufaceous sediments which are overlain by Quaternary fluvial and colluvial sediments.

The Lower Paleozoic sediments consist of the Silurian-Devonian Roberts Mountains Formation, the Devonian Popovich Formation, and the Rodeo Creek Formation. The Rodeo Creek Formation has been described in the mine area as the Ordovician-Silurian Vinini Formation, which was thrust over the Popovich Formation along the Roberts Mountain Thrust. Lower Paleozoic sediments are composed of a sequence of carbonate shelf, slope, and basin facies that have gradational contacts.

The Roberts Mountains Formation consists of carbonaceous calcareous siltstone to fine-grained sandstones. Sediments of the Roberts Mountains Formation have been observed at depth ranging from 1,400 to 1,500 feet below ground surface in the northern part of the site. The Popovich Formation consists of medium to thick-bedded carbonaceous silty to muddy limestones interbedded with calcareous siltstones and mudstones. Sediments of the Popovich Formation have been observed at depth ranging from 600 to 800 feet below ground surface. Sediments of the Rodeo Creek Formation are lithologically diverse and consist of thin- to medium-bedded siltstone, mudstone, argillite, limestone, chert, and fine-grained sandstone. Surface exposures of the Rodeo Creek Formation are found throughout the northern part of the proposed Betze Pit (Figure 3-1).

The granodioritic Jurassic-Cretaceous Goldstrike Stock intrudes the Lower Paleozoic sediments in the mine area. Contact metamorphism, as a result of the intrusion, has developed skarn (lime-bearing silicates) when in contact with the calcareous sediments, both at distance from the intrusive and locally within the intrusive. Numerous dikes and sills have intruded the sediments along structural zones. Surface exposures of the Goldstrike Stock are found throughout the southern part of the proposed Betze Pit (Figure 3-1).

Late Tertiary tufaceous, fluvial, and lacustrine sediments of the Carlin Formation mantle the Paleozoic rocks in the northern part of the mine area. The Carlin Formation, in turn, is overlain by varying thicknesses of unconsolidated Quaternary alluvium in the project area.

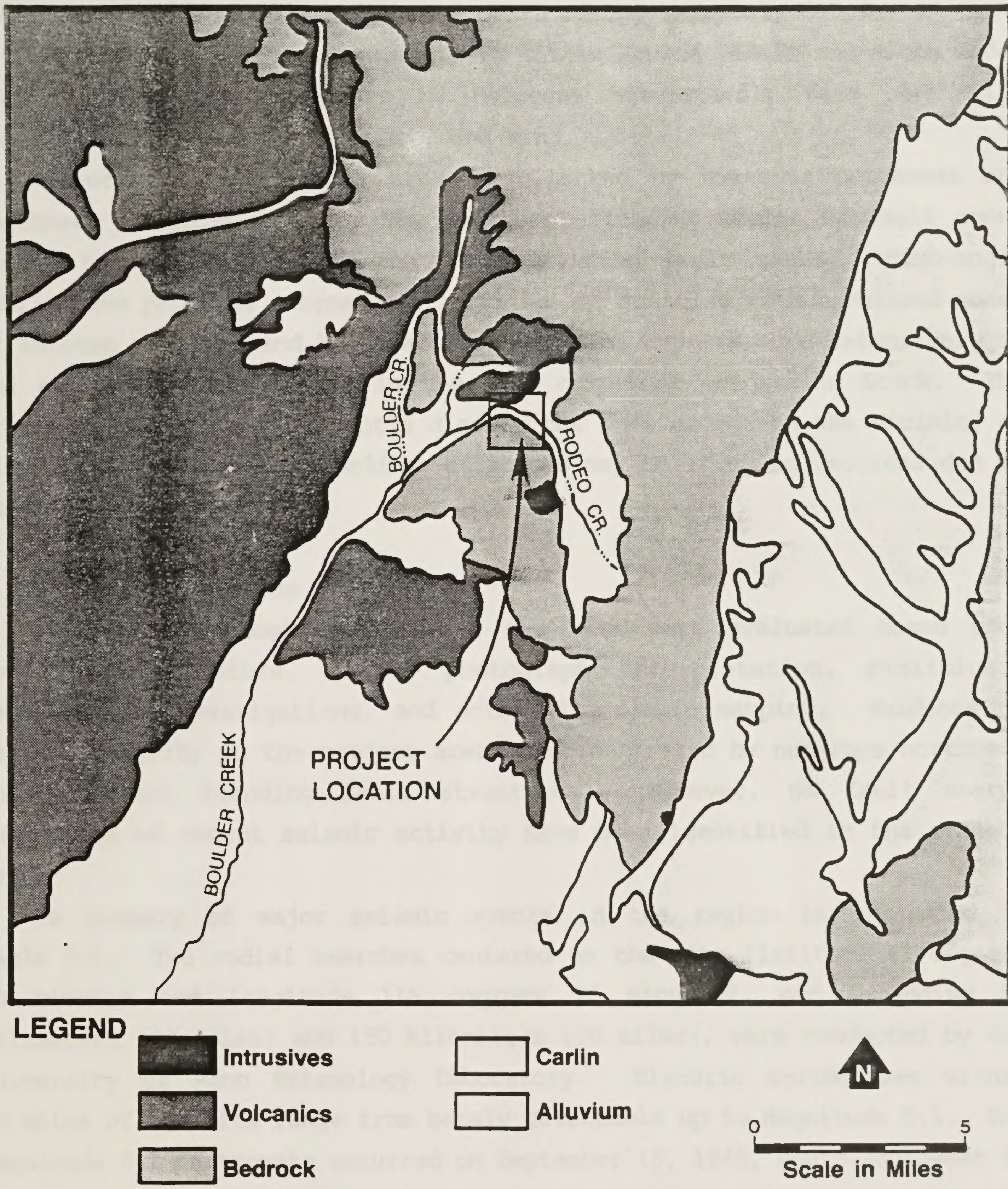
exposing sedimentary rocks of the geologic province. The geologic setting is composed of lower Paleozoic marine sediments, a Jurassic-Cretaceous intrusive, and late Tertiary volcanic sediments which are overlain by Quaternary fluvial and colluvial sediments.

The lower Paleozoic sediments consist of the Silurian-Devonian Roberts Mountains Formation, the Devonian Popovich Formation, and the Rodeo Creek Formation. The Rodeo Creek Formation has been described in the mine area as the Cambrian-Silurian Vinini Formation, which was thrust over the Popovich Formation along the Roberts Mountain Thrust. Lower Paleozoic sediments are composed of a sequence of carbonate shelf, slope, and basin facies that have gradational contacts.

The Roberts Mountains Formation consists of carbonaceous calcareous siltstone to fine-grained sandstone. Sediments of the Roberts Mountains Formation have been observed at depth ranging from 1,400 to 1,500 feet below ground surface in the northern part of the site. The Popovich Formation consists of medium to thick-bedded carbonaceous silty to muddy limestones interbedded with calcareous siltstones and mudstones. Sediments of the Popovich Formation have been observed at depth ranging from 690 to 850 feet below ground surface. Sediments of the Rodeo Creek Formation are lithologically diverse and consist of thin- to medium-bedded siltstone, mudstone, argillite, limestone, chert, and fine-grained sandstone. Surface exposures of the Rodeo Creek Formation are found throughout the southern part of the proposed Betze Pit (Figure 4-1).

The predominantly Jurassic-Cretaceous Goldstrike Stock intrudes the lower Paleozoic sediments in the mine area. Contact metamorphism, as a result of the intrusion, has developed skarn (lime-bearing silicates) when in contact with the calcareous sediments, both at distance from the intrusive and locally within the intrusive. Numerous dikes and sills have intruded the sediments along structural zones. Surface exposures of the Goldstrike Stock are found throughout the southern part of the proposed Betze Pit (Figure 4-1).

Late Tertiary volcanoes, alluvial, and lacustrine sediments of the Carlin Formation overlie the Paleozoic rocks in the northern part of the mine area. The Carlin Formation, in turn, is overlain by varying thicknesses of unconsolidated Quaternary alluvium in the project area.



BETZE DEVELOPMENT PROJECT

Figure 3-1. Surface Geology Map

Deep drilling in Little Boulder Basin indicates that the Paleozoic sequence underlies the Carlin Formation at a depth of approximately 600 feet.

Valley fill alluvial sediments in Little Boulder Basin and along Rodeo Creek consist of Quaternary to Holocene age gravel, sand, and silt deposited by streams, slope wash, and wind.

Structurally, the mine area is bisected by numerous northwest and northeast trending faults. The northeast trending faults or fault zones appear to have offset the northwest trending fault zones. High-angle faults have produced extensive fracturing and jointing with localized zones of intense shearing and brecciation. Jointing appears more extensively in the sedimentary rocks than in the more competent Goldstrike Stock. The stratigraphic units have gentle dips to the east except in the vicinity of high-angle faults, where bedding attitudes may be steep to vertical due to folding.

3.2.2 Geologic Hazards

Potential geologic hazards at the site were evaluated based upon available literature, aerial photograph interpretation, preliminary geotechnical investigations, and detailed geologic mapping. Evidence of seismic activity in the project area is demonstrated by numerous northwest and northeast trending fault structures. However, no fault scarps suggestive of recent seismic activity have been identified in the project area.

A summary of major seismic events in the region is presented in Table 3-1. Two radial searches centered on the site (latitude 41 degrees 00 minutes and longitude 116 degrees 25 minutes), and extending 50 kilometers (30 miles) and 150 kilometers (90 miles), were conducted by the University of Reno Seismology Laboratory. Historic earthquakes within 30 miles of the site range from barely detectable up to Magnitude 5.1. The Magnitude 5.1 earthquake occurred on September 18, 1945, south-southwest of the site. The 150 kilometer radial search of the area indicates the strongest historic earthquake in the area occurred on October 3, 1915, with a Magnitude 7.8. The epicenter of this earthquake correlates with the Pleasant Valley earthquake of 1915 (Table 3-1) and is located approximately 80 miles southwest of the mine site (von Hake 1974). Originally, the area of the site was classified as a Zone II seismic risk (NOAA 1973), but reclassified in 1985 to a Zone III seismic risk area

Deep drilling in Little Boulder Basin indicates that the Paleozoic section underlies the Carlin Formation at a depth of approximately 400 feet.

Valley fill alluvial sediments in Little Boulder Basin and Rodeo Creek consist of Quaternary to Holocene age gravel, sand, and silt deposited by streams, slope wash, and wind.

Structurally, the mine area is dissected by numerous northwest and northeast trending faults. The northwest trending faults or fault zones appear to have offset the northeast trending fault zones. High-angle faults have produced extensive brecciation and gouging with localized zones of intense shearing and brecciation. Faulting appears more extensively in the sedimentary rocks than in the more competent Goldstrike Stock. The stratigraphic units have 30° to 45° dips to the east except in the vicinity of high-angle faults, where bedding attitudes may be steep to vertical due to folding.

3.2.3 Geologic Hazards

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TABLE 3-1

MAJOR SEISMIC EVENTS IN NEVADA

Date	Epicenter Location	Intensity[1] Magnitude	Area[2] (mi^2)	Remarks
1845 poss. 1852	Stillwater area (?) poss. Pyramid Lake	greater than 7	unknown	Report based on boyhood recollection of local inhabitant. Shock knocked down people, shook river bank, may have diverted river.
Mar. 26, 1872	Owens Valley, CA	X-XI approx. 8	640,000	23 persons killed, 60 injured in Lone Pine; 52 houses (mostly adobe) destroyed. Faulting along east side of Owens Valley extended for more than 41 mi; scarps up to 23 ft high.
Oct. 2, 1915	Pleasant Valley	X approx. 7.8	500,000	Faulting for 20-25 mi along west face of Sonoma Range, scarps up to 13 ft high. All buildings destroyed in Kennedy; chimneys toppled, walls cracked in Winnemucca. Mine tunnels caved in; water tanks fell, roads cracked.
Dec. 20, 1932	Cedar Mountains	X 7.3	500,000	Created fissures; zone of rupture 37 mi long, 4-9 mi wide. Chimneys toppled in Mina and Luning. Boulders dislodged from hillsides. Groundwater flow changed.
Dec. 16, 1954	Fairview Peak and Dixie Valley (2 events 4 min. apart. Fairview Peak approx. 34 mi south of Dixie)	X 7.1; 6.8	200,000	These two earthquakes produced two zones of surface rupture; southern (Fairview zone 30 mi long, 6 mi wide; northern zone (Dixie) 25 mi long, 3 mi wide. Highways cracked, groundwater flow changed.

Sources: National Oceanic and Atmospheric Administration. 1973. Earthquake history of the United States. NOAA Environmental Data Service Publication 41-1.

Ryall, A. 1977. Earthquake hazard in the Nevada region.

Bulletin of the Seismological Society of America. Volume 67, no. 2, April.

[1]Roman numeral represents intensity as measured on the Modified Mercalli Intensity Scale. Arabic number represents magnitude as measured on the Richter Scale.

[2]Area represents the area over which the effects of the earthquake were felt. Figures given are estimates; in many cases (particularly in the 1800s), information on the extent of earthquake effects is very sketchy, relying on the recollections of a few individuals in sparsely populated areas. The low population density also accounts for the limited damage to property.

(Uniform Building Code 1985). Such an area could expect moderate to major damage (NOAA 1973).

Within the mine area itself, numerous faults exist; however, there is no indication of recent (historical) movement on these faults. Regionally, a north-northeast Basin and Range fault is apparent within Boulder Valley along Boulder Creek and separates the rocks of the Sheep Creek Range from the rocks of the mine area within the western Tuscarora Mountains. Faulting and tilting of the blocks within the Basin and Range Province took place in post-early Pleistocene time (Roberts, Montgomery and Lehner 1967).

Secondary seismic effects due to liquefaction of saturated sandy soils are limited by the dry climate and depth to groundwater. Where alluvial soils occur in the project area, seismic liquefaction could occur if susceptible soils become saturated. Isolated occurrences of expansive clay in residual soils may be present beneath alluvial soils. Kaolinite and non-expansive clays are observed along argillic altered fault zones within the proposed mine area. No active or potential landslides or rockfall hazards were noted during surficial mapping at the project site. The limiting factors are the dry climate, thin upland soils, and general lack of clay soils.

3.2.3 Mineral Resources

During the early twentieth century, the development of placer deposits along Lynn, Sheep, and Rodeo Creek valleys initiated economic recovery of gold from the area. Historic mining activities in the mine area consist of exploration pits and shallow workings. There are numerous exploration pits in the area of the Goldstrike Stock southeast of the mine area. During the 1950s, turquoise was mined from workings southeast of the mine area. In 1965, discovery of a large, low grade, disseminated gold ore body at the Carlin Mine stimulated prospecting for this type of deposit throughout Nevada.

Locally, gold mineralization is hosted by the Popovich Formation (Betze Ore Deposit, Lower Post Ore Deposit, and Screamer Ore Deposit), Rodeo Creek Formation, and the Goldstrike Stock. The largest ore deposits, the Betze and Lower Post, occur in the silty limestones of the Popovich Formation. The smaller deposits in the Rodeo Creek Formation occur in calcareous siltstone to fine grained sandstone interbedded in

(Uniform Building Code 1985). Such an area could expect moderate to major damage (NCRB 1973).

Within the mine area itself, numerous faults exist; however, there is no indication of recent (Holocene) movement on these faults. Regionally, a north-northwest Basin and Range fault is apparent within Boulder Valley along Boulder Creek and separates the rocks of the Sheep Creek Range from the rocks of the mine area within the southern Tuscarora Mountains. Faulting and tilting of the blocks within the Basin and Range Province took place in post-early Pleistocene time (Roberts, Montgomery and Lehner 1967).

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siliceous rocks. These deposits are oxidized and generally low in sulfide content.

Ore deposits occur in isolated tabular to lenticular ore bodies which appear to be structurally controlled. Alteration associated with mineralization appears to be propylitic, argillic, and silicic with possible weak potassic mineralization. Argillic alteration has produced kaolinite clay predominantly along structures. Supergene weathering has produced oxides and sulfates to depths of up to 400 feet.

Gold mineralization in the Betze Deposit consists of oxide and sulfide ore zones. Oxide ore zones consist of micron-size gold disseminated in iron oxides and hydroxides which have been produced by the oxidation of the sulfide ore. Oxide ore zones extend to depths ranging from 300 to 900 feet below the surface. Sulfide ore deposits consist of disseminated, gold bearing, arsenian pyrite and marscasite which characteristically contain a higher grade of gold than the oxide ore. Sulfide ore zones are delineated to a minimum depth of 1,800 feet below ground surface.

According to Barrick's Plan of Operations Amendment (April 1989), the minable reserves contained within the proposed Betze pit are: 60.8 million tons of oxide ore grading 0.029 ounces gold per ton; 81.4 million tons of sulfide ore grading 0.159 ounces gold per ton; and 816 million tons of waste rock. Based on data from drilling on 200-foot centers, mine feasibility studies have estimated the Betze Ore Deposit to be approximately 7,000 feet long and 1,880 feet wide with vertical thicknesses as great as 600 feet. Current ore reserve estimates of combined oxide and sulfide mineralization are 15.1 million contained ounces of gold.

Exploration for additional reserves is ongoing, and future reserves could include extensions of the identified ore bodies, low-grade ore deposited as waste rock, and other as yet undiscovered ore bodies in the area.

3.2.4 Paleontology

No paleontological resources or potentially important geological formations have been identified at or near the project area (Mohsen 1990). Megascopic fossils observed in the mine area are known to occur throughout

siliceous rocks. These deposits are oxidized and generally low in sulfide content.

Ore deposits occur in irregular tabular to lenticular ore bodies which appear to be structurally controlled. Alteration associated with mineralization appears to be propylitic, argillic, and silicic with possible weak potassic mineralization. Argillic alteration has produced kaolinite clay predominantly along structures. Supergene weathering has produced oxides and sulfates to depths of up to 400 feet.

Gold mineralization in the Betze Deposit consists of oxide and sulfide ore zones. Oxide ore zones consist of micron-size gold disseminated in iron oxides and hydroxides which have been produced by the oxidation of the sulfide ores. Oxide ore zones extend to depths ranging from 200 to 900 feet below the surface. Sulfide ore deposits consist of disseminated, gold bearing, arsenian pyrite and marcasite which characteristically contain a higher grade of gold than the oxide ore. Sulfide ore zones are delineated to a minimum depth of 1,800 feet below ground surface.

According to Barrick's Plan of Operations Amendment (April 1989), the minable reserves contained within the proposed Betze pit are: 40.8 million tons of oxide ore grading 0.025 ounces gold per ton; 61.4 million tons of sulfide ore grading 0.190 ounces gold per ton; and 816 million tons of waste rock. Based on data from drilling on 200-foot centers, mine feasibility studies have estimated the Betze Ore Deposit to be approximately 7,000 feet long and 1,880 feet wide with vertical thicknesses as great as 800 feet. Current ore reserve estimates of combined oxide and sulfide mineralization are 15.1 million contained ounces of gold.

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3.3.4 Paleontology

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the western rock assemblages. No significant fossils are known to be indigenous or site specific to the proposed mine area.

3.3 Air Resources

Baseline meteorology, air quality, and dispersion conditions representative of the Betze Project area were estimated using data from the Betze Project and other nearby monitoring stations in northcentral Nevada.

3.3.1 Temperature and Precipitation

Table 3-2 presents summaries of temperature and precipitation data from the monitoring station at the Betze Project area and at the following other stations: Elko (56 miles east, southeast), Beowawe (27 miles south), and Tuscarora (25 miles north). These stations are similar in elevation and terrain to the project site, thus data from these stations are deemed representative of the project location.

Temperature data indicate relatively wide diurnal and seasonal variability which is typical of dry climates such as Nevada. The high elevation and proximity of mountains also contribute to the wide range of temperatures. Warmest temperatures are in late July and early August with coldest temperatures in January and February. For the fourth quarter of 1989 and the first quarter of 1990, the Betze Project temperature extremes ranged from a high of 75.7°F (October 10, 1989) to a low of 1.9°F (February 15, 1990) for a 6-month average of 36°F. Measured extremes during the 29-year data base at Elko and Beowawe range from 104°F in the summer to -38°F in the winter. During 1986 at Tuscarora, the extremes ranged from 95°F on August 10 to -3°F on February 10. The 1986 annual mean temperature at Tuscarora of 46°F compares closely to those of Elko and Beowawe; thus the temperature extremes are deemed representative of a typical year in the region.

Precipitation in the region is relatively sparse, averaging only about 8 to 10 inches annually. The 29-year precipitation data of Elko and Beowawe show heaviest amounts falling during the winter as snow and as rain in May and June. Summer precipitation occurs mostly as scattered showers and thunderstorms and makes only a minor contribution to overall precipitation totals. For the first quarter of 1990, total precipitation on site measured 2.31 inches, which is comparable to the Elko precipitation figures for the same period.

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TABLE 3-2

REGIONAL TEMPERATURE AND PRECIPITATION DATA

Station	Elevation in Feet	Years of Record	Period of Record		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Maximum, Minimum, and Mean Temperatures (°F)																	
Elko	5,050	29	1941-1970	Max	58.0	67.0	77.0	83.0	92.0	101.0	102.0	102.0	99.0	86.0	74.0	59.0	102.0
				Min	-38.0	-28.0	-9.0	4.0	10.0	23.0	32.0	25.0	12.0	8.0	-11.0	-22.0	-38.0
				Mean	23.3	29.4	35.0	43.5	51.8	59.6	69.6	67.0	57.5	46.9	34.8	25.8	45.4
Beowawe	4,684	29	1941-1970	Max	65.0	70.0	79.0	84.0	94.0	102.0	104.0	104.0	101.0	91.0	75.0	64.0	104.0
				Min	-29.0	-10.0	-4.0	10.0	12.0	17.0	31.0	24.0	8.0	2.0	9.0	-23.0	-29.0
				Mean	27.2	33.7	38.5	46.5	54.7	61.6	70.5	67.6	58.2	48.6	37.0	29.2	47.8
Tuscarora	6,170	1	1986	Max	NA	NA	NA	NA	NA	NA	NA	95.0	NA	NA	NA	NA	95.0
				Min	NA	-3.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-3.0
				Mean	33.4	33.3	41.5	40.9	49.8	63.3	64.3	69.8	50.1	45.2	35.3	29.5	46.4
Betze Project[1]	5,500	<1	1989-1990	Max	57.2	52.9	64.2							75.7	65.3	51.8	75.7
				Min	5.5	1.9	15.8							19.6	12.0	14.7	1.9
				Mean	30.2	27.9	41.0							47.8	37.6	31.5	36.0
Mean Monthly Precipitation (Total Inches)																	
Elko	5,050	29	1941-1970		1.16	0.77	0.82	0.82	1.02	1.01	0.40	0.61	0.33	0.66	1.01	1.12	9.73
Beowawe	4,684	29	1941-1970		0.68	0.59	0.55	0.85	1.00	1.07	0.27	0.35	0.34	0.57	0.80	0.87	7.94
Tuscarora[2]	6,170	1	1986		0.49	1.56	1.18	0.79	0.66	0.06	0.70	0.10	1.09	0.46	0.57	0.01	7.67
Betze Project[3]	5,500	0.5	1989-1990		1.22	0.40	0.69										2.31

Data Source: National Climatic Data Center, Asheville, North Carolina.

NA - Not available.

[1]Only two quarters of data available.

[2]Precipitation data at Tuscarora are monthly totals for 1986.

[3]First full month of data was January 1990.

3.3.2 Winds

The Betze Project site is located in complex terrain where winds are strongly influenced by topographical features. These data are presented in Figure 3-2 and Table 3-3. On-site data for the 6-month period (October 1, 1989 to March 31, 1990) showed calm winds; wind speeds less than 1 mile per hour (mph) occurred 2.5 percent of the time. Wind speeds were less than 11 mph 88 percent of the time. Wind speeds greater than 18 mph occurred 2.2 percent of the time. The mean wind speed for the period was 6 mph, with the maximum wind gust of 42 mph occurring on January 26 and 29, 1990.

Terrain also influences wind direction by creating "channels" for the winds to follow. During nighttime, dense cool air flows downslope from the northeast along the drainage. During daytime, lighter warm air flows upslope from the west-southwest. The most common wind direction is 40 to 60 degrees (northeasterly) with an occurrence of 27 percent for the 6-month period, occurring mostly as nighttime air drainage. The second most common direction is 240 to 270 degrees (west-southwesterly) with an occurrence of 15 percent for the period, occurring mostly as daytime upslope winds. For the remainder of wind directions, most occurred during less than 6 percent of the period. The orientation of the topography at the project site is similar to that of Elko and, as a result, wind direction frequencies are expected to be similar to those of Elko.

Figure 3-3 illustrates a windrose for Elko, and Table 3-3 presents the digital wind speed and direction frequency distribution data for the year 1981. These data indicate a maximum wind direction frequency from the southwest and west-southwest with a secondary maximum from the north and northeast. Average wind speed is about 6.7 mph, with 68 percent of the observations less than 7.5 mph. Southwesterly winds are generally the strongest at an average velocity of 8.5 mph, while north-northwesterly winds are lightest at an average velocity of 4.0 mph.

3.3.3 Dispersion Conditions

Dispersion conditions are affected strongly by two parameters: stability and mixing depth. Stability defines the ability of the atmosphere to disperse a given pollutant concentration. Unstable conditions represent maximum dispersion, while stable conditions represent

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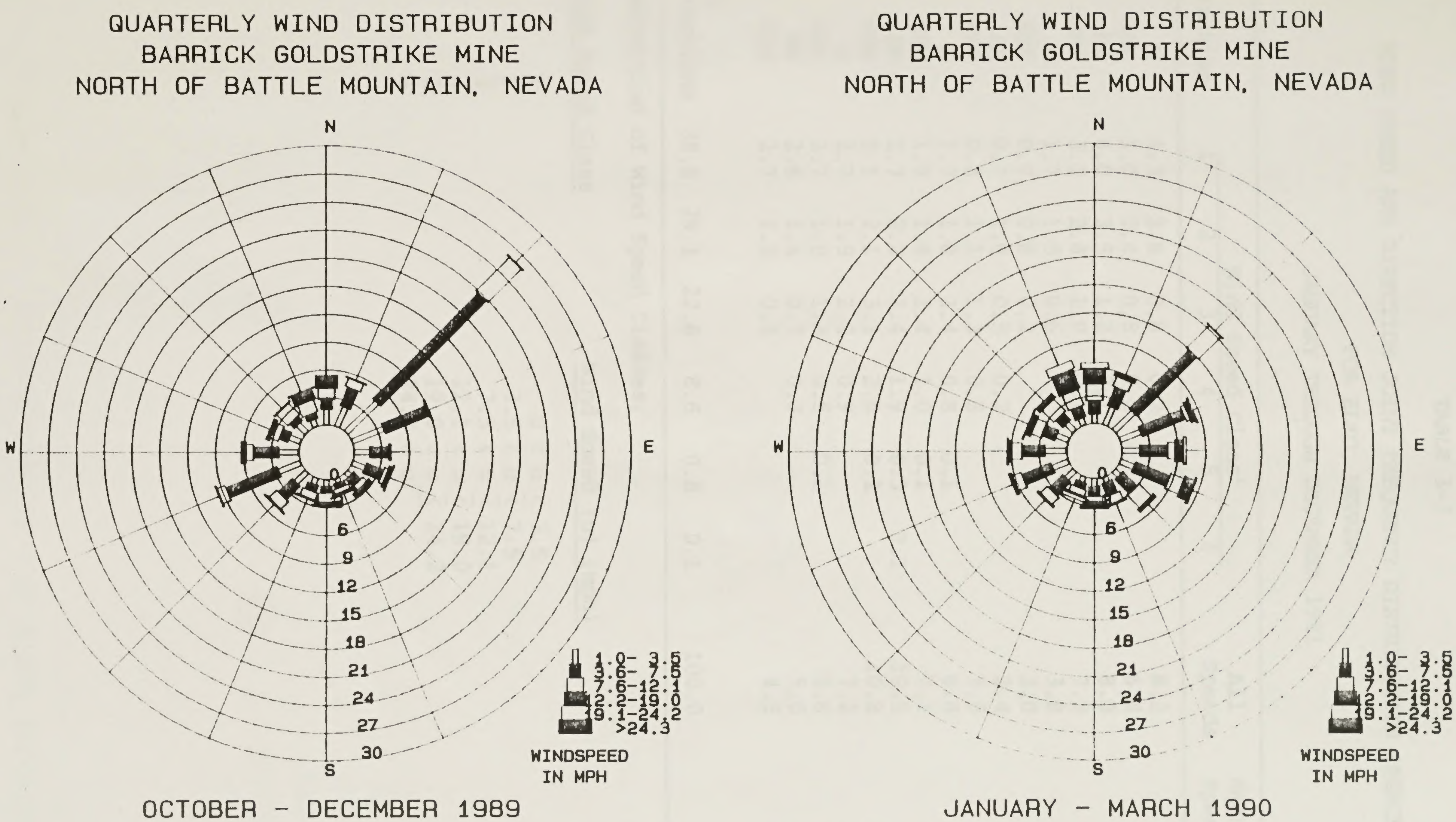

Figure 3-2 STAR WIND ROSES FOR BETZE PROJECT SITE

TABLE 3-3

WIND SPEED AND DIRECTION JOINT FREQUENCY DISTRIBUTION (PERCENT)

FOR ELKO, NEVADA

JANUARY THROUGH DECEMBER 1981

Direction	Wind Speed Class[1]						All Speeds	Mean Wind Speed (mph)
	1	2	3	4	5	6		
N	4.3	2.8	0.8	0.2			8.2	4.5
NNE	3.0	2.4	0.8	0.2			6.4	4.7
NE	4.0	3.5	1.2	0.1			8.9	4.7
ENE	3.3	2.8	1.0	0.1			7.3	4.9
E	1.7	1.5	0.6				3.8	4.7
ESE	0.9	0.8	0.2				2.0	4.7
SE	0.7	1.0	0.5	0.2			2.4	6.5
SSE	0.8	1.1	1.3	0.3			3.5	7.6
S	1.7	1.8	2.4	0.8	0.1		6.8	7.6
SSW	1.9	1.6	2.4	1.0	0.1		7.1	8.1
SW	2.7	2.2	3.4	1.9	0.3	0.1	10.5	8.5
WSW	3.1	2.1	3.3	2.0	0.2		10.8	8.3
W	2.7	1.5	2.2	0.9			7.2	6.9
WNW	2.7	1.0	1.3	0.5	0.1		5.6	6.0
NW	2.6	1.4	0.7	0.3			5.0	4.9
NNW	2.7	1.5	0.4				4.5	4.0
All Directions	38.8	29.1	22.6	8.6	0.8	0.1	100.0	

[1]Definition of Wind Speed Classes:

Wind Speed Class	Wind Speed (u) (mph)
1	$0 < u \le 3.5$
2	$3.5 < u \le 7.5$
3	$7.5 < u \le 12.1$
4	$12.1 < u \le 19.0$
5	$19.0 < u \le 24.2$
6	$24.2 < u$

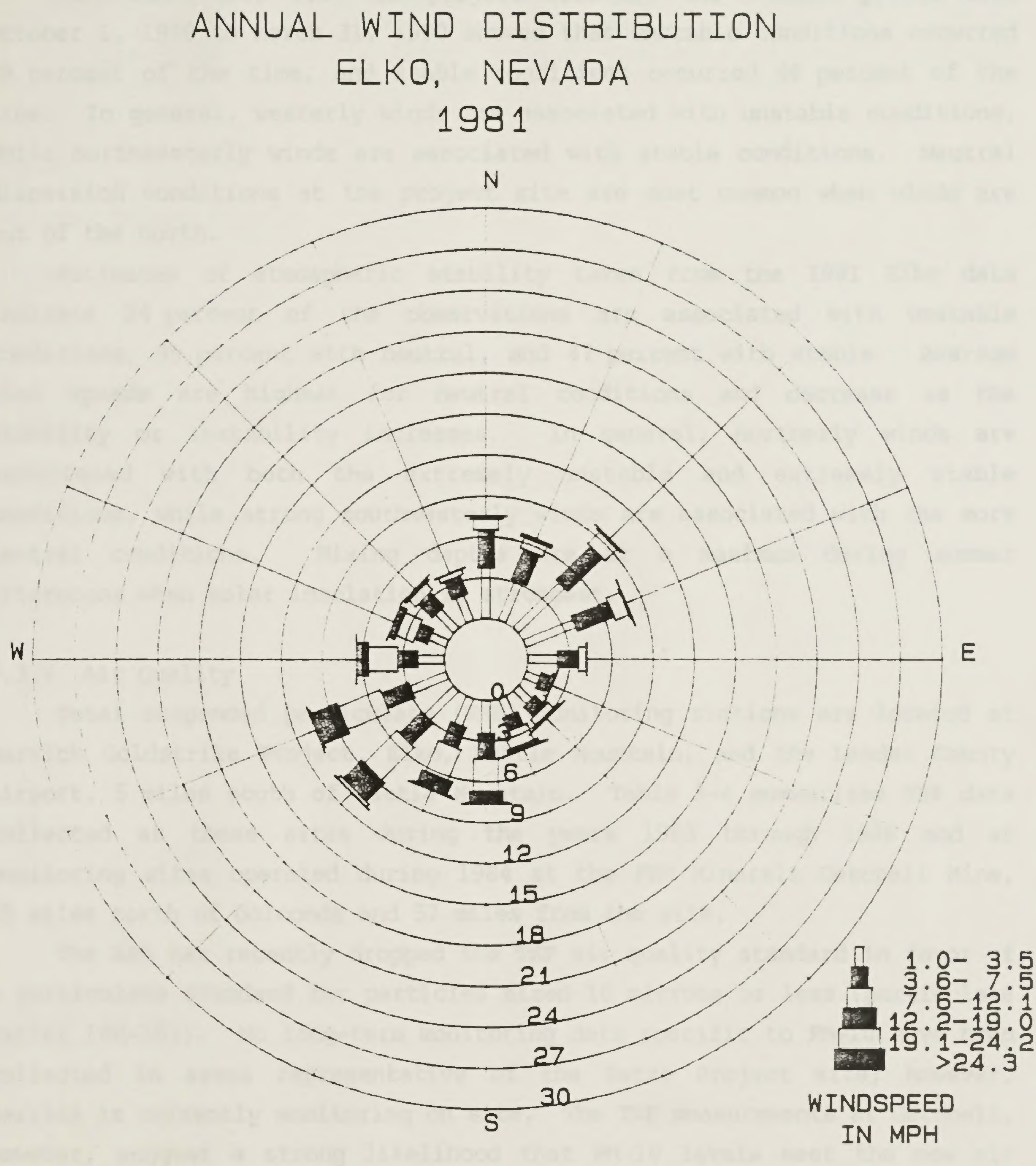

Figure 3-3 STAR WINDROSE FOR ELKO, NEVADA

minimum dispersion. Mixing depth defines the atmospheric volume through which dispersion may take place.

Dispersion data from the project site for the 6-month period from October 1, 1989 to March 31, 1990 showed that unstable conditions occurred 29 percent of the time, and stable conditions occurred 46 percent of the time. In general, westerly winds are associated with unstable conditions, while northeasterly winds are associated with stable conditions. Neutral dispersion conditions at the project site are most common when winds are out of the north.

Estimates of atmospheric stability taken from the 1981 Elko data indicate 24 percent of the observations are associated with unstable conditions, 30 percent with neutral, and 47 percent with stable. Average wind speeds are highest for neutral conditions and decrease as the stability or instability increases. In general, northerly winds are associated with both the extremely unstable and extremely stable conditions, while strong southwesterly winds are associated with the more neutral conditions. Mixing depths are at a maximum during summer afternoons when solar insolation is strongest.

3.3.4 Air Quality

Total suspended particulate (TSP) monitoring stations are located at Barrick Goldstrike Project, Elko, Battle Mountain, and the Lander County Airport, 5 miles south of Battle Mountain. Table 3-4 summarizes TSP data collected at these sites during the years 1983 through 1986 and at monitoring sites operated during 1984 at the FRM Minerals Getchell Mine, 15 miles north of Golconda and 52 miles from the site.

The EPA has recently dropped the TSP air quality standard in favor of a particulate standard for particles sized 10 microns or less (particulate matter [PM-10]). No long-term monitoring data specific to PM-10 have been collected in areas representative of the Betze Project site; however, Barrick is currently monitoring on site. The TSP measurements at Getchell, however, suggest a strong likelihood that PM-10 levels meet the new air quality standards.

PM-10 monitoring station is located at the project site. Particulate data from the Barrick Goldstrike Project for the 6-month period (October 1, 1989 to March 31, 1990) showed no violations of the Nevada state standard for TSP. The highest 24-hour PM-10 concentration was 52 micrograms per

TABLE 3-4

SUMMARY OF REGIONAL PARTICULATE DATA ($\mu g/m^3$)

Type	Year/Site	Annual Geometric Mean[1]	24-Hour Maximum Concentration[1]	Number of Samples Exceeding Standards: Nevada $>150\mu g/m^3$	Federal $>260\mu g/m^3$
TSP	1983				
	Elko	41.9	104	0	0
	Battle Mountain	76.8	149	0	0
	Lander County Airport	14.1	43	0	0
	1984				
	Elko	70.3	213	4	0
	Battle Mountain	116.3	498	10	2
	Lander County Airport	19.6	391	1	1
	FRM - Getchell Mine (Met Site)	9.2	73	0	0
	FRM - Getchell Mine (Airstrip Site)	9.3	64	0	0
	FRM - Getchell Mine (Mill Site)	9.9	77	0	0
	1985				
	Elko	55.8	248	1	0
	Battle Mountain	102.0	220	4	0
	Lander County Airport	25.8	253	1	0
	1986				
	Elko	51.1	109	0	0
	Battle Mountain	74.8	175	1	0
	Lander County Airport	18.4	80	0	0
PM-10	1989/1990				
	Barrick Goldstrike North Block[3]	12.4[4]	52	0	0

TABLE 3-4 (CONTINUED)

FOOTNOTES:

[1] Particulate Standards ($\mu g/m^3$):

	Nevada	Federal Primary	Federal Secondary
TSP			
24-Hour[2]	150	260	150
Annual Geometric Mean	75	75	60
PM-10			
24-Hour[2]	--	150	--
Annual Arithmetic Mean	--	50	--

[2] Not to be exceeded more than once per year.

[3] Only two quarters available, 4th quarter 1989 and 1st quarter 1990.

[4] Six-month arithmetic mean.

cubic meter ($\mu g/m^3$), collected on February 16, 1990. The arithmetic average for the period was 12.4 $\mu g/m^3$. Data from the Elko, Battle Mountain, and Lander County Airport sites show occasional violations of the Nevada state standard for TSP. However, the Elko and Battle Mountain TSP samplers are located in areas where TSP concentrations are greatly influenced by the effects of urban activity (e.g., automobile traffic on dirt roads, construction work, street repair, etc.). The TSP samplers at the FRM Minerals Getchell Mine were located in a more rural environment. Thus,data at this site would be more representative of the ambient baseline TSP concentration in the Betze Project area. These data show no violations of the Nevada state nor federal 24-hour and annual standards.

3.4 Water Resources

The description of existing water resources in the Betze Project area is divided into surface water and groundwater subsections. Within each subsection there is a discussion of the physical constraints of the respective hydrologic systems and a presentation of existing water quality data. The hydrology of the mine is placed in context by discussing the regional and local settings of both the surface water and groundwater systems.

3.4.1 Surface Water

Surface runoff from the project area flows west and southwest via Rodeo Creek, Boulder Creek, and Rock Creek (Figure 3-4) into the Humboldt River near Battle Mountain, Nevada, a distance of approximately 40 miles from the proposed Betze Project. Several springs in the upstream portions of the Boulder Creek, Bell Creek, Brush Creek, and Rodeo Creek drainages are shown on the USGS 7.5-minute quadrangle topographic maps for the area, and appear to provide perennial flow in the upper reaches of these stream systems. However, flow in these drainages infiltrates the alluvial aquifer adjacent to the stream, and all creeks downstream of the project area are ephemeral to the Humboldt River. Surface flow reaches the Humboldt River only during rare or extreme precipitation events.

There are no permanent stream gazing stations within the project area or within the Boulder Creek drainage basin. The closest U.S. Geological Survey (USGS) gazing station is located on Rock Creek approximately

cubic meter (ug/m3), collected on February 16, 1985. The arithmetic average for the period was 12.4 ug/m3. Data from the Elko, Battle Mountain, and Lander County Airport sites show occasional violations of the Nevada state standard for TSP. However, the Elko and Battle Mountain TSP samplers are located in areas where TSP concentrations are greatly influenced by the effects of urban activity (e.g., automobile traffic on dirt roads, construction work, street repair, etc.). The TSP samplers at the FMC Minerals Getchell Mine were located in a more rural environment. Thus, data at this site would be more representative of the ambient baseline TSP concentration in the Betze Project area. These data show no violations of the Nevada state nor federal 24-hour and annual standards.

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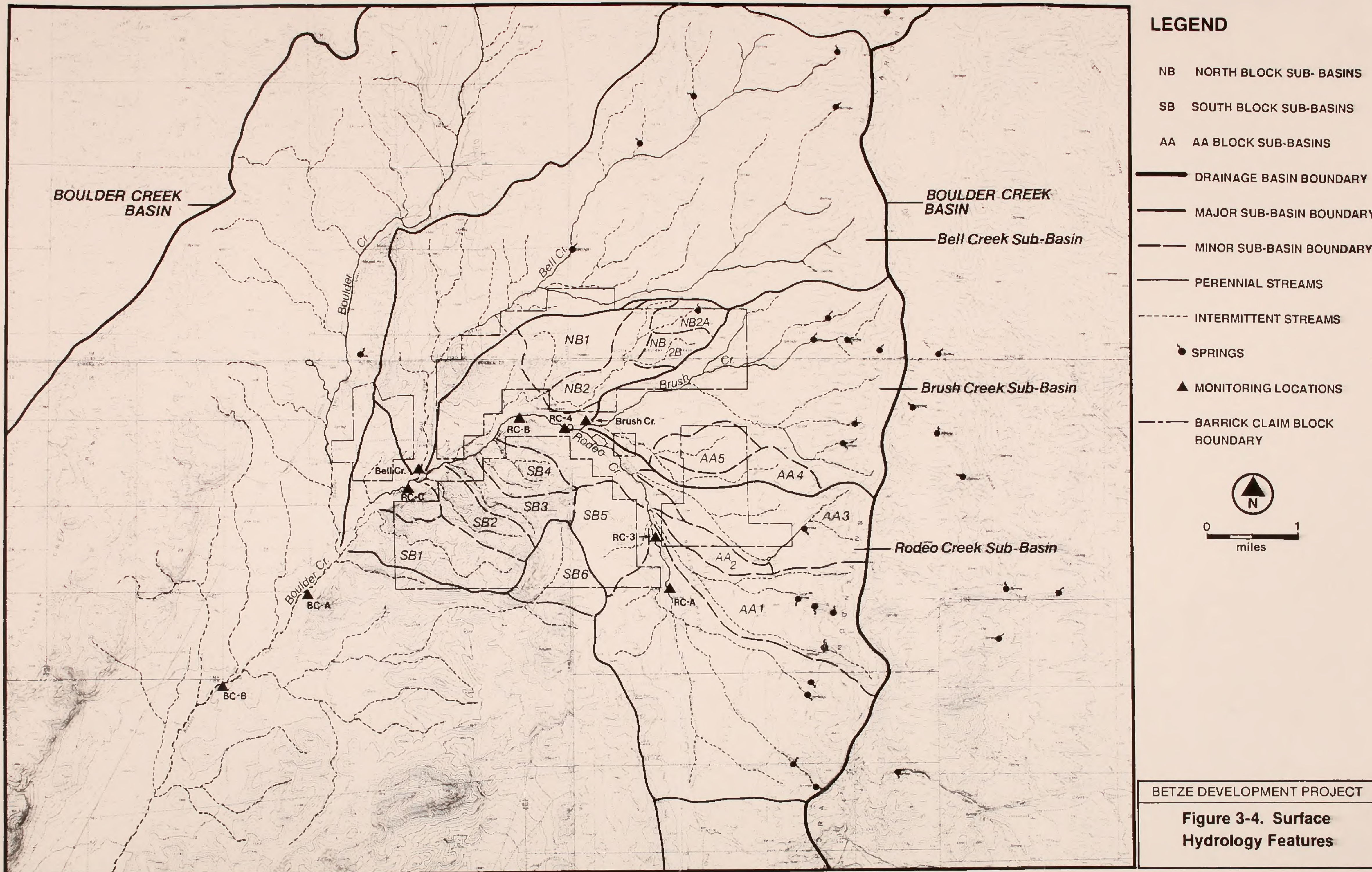
There are no permanent stream gaging stations within the project area or within the Boulder Creek drainage basin. The closest U.S. Geological Survey (USGS) gaging station is located on Rock Creek approximately



BETZE DEVELOPMENT PROJECT

Figure 3-4. Surface Hydrology Features

25 miles southwest of the project area upstream of its confluence with Boulder Creek. At this location the drainage area of the basin is approximately 875 square miles (mi^2) and the mean annual discharge is 34 cubic feet per second (cfs) with approximately 25,000 acre-feet of runoff. Rock Creek dries up at times between July and October almost every year (USGS 1978).

Several nearby gauging stations are located on the Humboldt River which flows from east to west approximately 30 to 40 miles south of the project area. The three closest stations, from upstream to downstream, are located at Palisade, Nevada near Aryenta, Nevada and at Battle Mountain, Nevada. Drainage area for the three stations ranges from about 5,000 mi^2 to 8,900 mi^2; mean annual discharge ranges from about 370 cfs to 530 cfs; and runoff ranges from about 240,000 acre-feet to 270,000 acre-feet. Discharge records are influenced by numerous irrigation diversions.

The Rodeo Creek drainage begins at a low divide with Sheep Creek 2.5 miles southeast of the project area and flows to the north for about 3 miles. At this point, which is just to the east of the present Post Pit, the creek begins a slow curve to the west and southwest through the project area to the confluence with Boulder Creek (Figure 3-4). Rodeo Creek flows perennially from springs at the southwest corner of the project area to a point just above its confluence with Boulder Creek. A reservoir is located on Rodeo Creek just upstream from the confluence with Brush Creek. The reservoir discharges water only during high flows (BLM 1988a). The depth of the incised Rodeo Creek channel varies from about 4 feet to 24 feet (BLM 1988a) indicating that reaches of the stream are incised into the valley floor. Just below the reservoir, Rodeo Creek reappears as a series of springs along a bedrock outcrop that apparently brings groundwater flow to the surface (BLM 1988a). The bed of Rodeo Creek consists predominantly of gravel with minor amounts of cobbles and silt (BLM 1988a).

Brush Creek enters Rodeo Creek from the northeast about 3.5 miles above the confluence with Boulder Creek. Brush Creek is perennial from a spring in the headwaters of one of its tributaries to its confluence with Rodeo Creek. The stream channel is incised in its lower portions to a depth of about 10 feet. The channel bed consists almost entirely of gravel with 10 percent or less silt (BLM 1988a).

Bell Creek enters Rodeo Creek from the north about 1.5 miles upstream of the confluence of Rodeo Creek and Boulder Creek. The stream flows perennially in its upper reaches north of the project area, but becomes ephemeral about 2 miles above its confluence with Rodeo Creek. The lower portion of the channel contains a short reach with perennial pools maintained by subsurface flow (BLM 1988a).

Boulder Creek flows to the south from its headwaters north and east of the project area in the Tuscarora Mountains. The creek turns to the south-southwest at the confluence with Rodeo Creek and continues in that direction toward the Humboldt River. Most of the upper reaches of Boulder Creek are perennial due to springs in the headwater areas. The creek becomes ephemeral about 1 mile above its confluence with Rodeo Creek and remains ephemeral until its confluence with Rock Creek. The stream channel of Boulder Creek is wide and shallow with depths of less than 3 feet and widths of about 50 feet (BLM 1988a). The stream bed consists of boulders, cobbles, and gravel with minor amounts of silt.

The extent of perennial flow in all of the creeks in the project area varies with seasonal variations in precipitation. In fact, Rodeo Creek was dry during the summer months of 1988 (BLM 1988b). Flow measurements were obtained by Barrick in March 1989 at three sites on Rodeo Creek, one site each on Bell Creek and Brush Creek, and four sites on Boulder Creek (Table 3-5).

Average annual precipitation for the area is approximately 9.7 inches based upon long-term records from a recording rain gauge in Elko, Nevada. Rainfall amounts for the 10-, 25-, 50-, and 100-year, 6-hour precipitation events are, respectively, 1.2, 1.4, 1.6, and 1.8 inches (Miller et al. 1973).

Floodplain mapping for Eureka County, Nevada has been performed by the Federal Emergency Management Agency (FEMA) (FEMA 1982). A flood hazard boundary map of the project area including both Boulder Creek and Rodeo Creek depicts the 100-year floodplain (Zone A) for both creeks. The mapped floodplain of Rodeo Creek extends approximately 1,000 feet above the confluence of Rodeo Creek and Bell Creek. The project facilities are located upstream of this point.

An inventory of springs and seeps within the vicinity of the project (JBR Consultants Group 1990) was undertaken during October and November 1989 to establish background flow rates and water chemistry within an area

Bell Creek enters Rodeo Creek from the north about 1.5 miles upstream of the confluence of Rodeo Creek and Boulder Creek. The stream flows perennially in its upper reaches north of the project area, but becomes ephemeral about 2 miles above its confluence with Rodeo Creek. The lower portion of the channel contains a short reach with perennial pools maintained by subsurface flow (BLM 1988a).

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TABLE 3-5

SURFACE WATER FLOW MEASUREMENTS[1]

Date	Station[2]	Flow cfs	Flow gpm
3/12/89	RC-B	6.5	2,920
3/12/89	RC-C	5.5	2,470
3/12/89	Bell Creek	17.2	7,710
3/12/89	BC-A	74	33,190
3/12/89	BC-B	71	31,840
3/13/89	RC-A	~0.033	~15
3/13/89	Brush Creek	4.5	2,020
3/13/89	Boulder Creek above Rodeo Creek confluence	47.5	21,300
3/13/89	BC-B	63	28,260
3/13/89	Boulder Creek approximately 2 miles below BC-B	62	27,810

[1] Data collected by JBR Consultants Group.

[2] See Figure 3-4 for location of flow measurement sites.

that could potentially be impacted by mining. The inventory identified 131 springs or seeps within a study area that encompasses the headwaters of Boulder, Bell, Brush, and Rodeo Creeks as well as tributaries to Maggie Creek on the eastern flank of the Tuscarora Mountains and upper Boulder Valley. With the exception of a small spring adjacent to Rodeo Creek about 1 mile upstream from the confluence with Bell Creek, all springs and seeps are upgradient from the proposed Betze Pit and related facilities. The full report is included in Appendix B-1.

The majority of the springs and seeps are located east and north of the project area on the western flank of the Tuscarora Mountains and in the headwaters of Boulder, Bell, and Brush Creeks. Observed flow rates vary from a high of 22 gallons per minute (gpm) at a spring in upper Bell Creek to less than 1 gpm at numerous sites throughout the study area. Generally, the springs with flow rates greater than 1 gpm are located within about 2 miles of the divide between the Boulder Creek drainage and Maggie Creek to the east.

Water samples from 26 springs or seeps were collected and submitted for chemical analysis. Fourteen samples were analyzed for arsenic with an average concentration of 0.044 milligrams per liter (mg/l) and a maximum concentration of 0.063 mg/l. Enormously high levels of sulfate and TDS were detected in a spring on the west edge of the Clydesdales Block. These levels suggest that the water from the spring has been in contact with sulfide minerals and that oxidizing of sulfides has taken place followed by neutralization to obtain the present pH of 8.18. The remainder of the samples have an average sulfate level of 87 mg/l and an average TDS of 321 mg/l.

3.4.1.1 Peak Flows and Runoff. Peak flows and runoff for existing drainages within the proposed Betze Project area were estimated utilizing the Soil Conservation Service (SCS) Graphical Curve Number Method (SCS 1972). Drainage basins for which hydrologic computations have been made are shown in Figure 3-4, and the results of the computations are tabulated in Table 3-6. Basins were delineated on USGS 7.5-minute quadrangle maps. The selection of basins for inclusion in the analysis was based upon the extent of disturbance that would occur within the basin. Therefore, there are some small basins for which hydrologic computations were not necessary. Peak flows may occur during the months of April, May, and June

TABLE 3-6

DRAINAGE BASIN FLOW SUMMARY

Basin	Area (acres)	SCS Curve No.	Peak Discharge (cfs)				Runoff Volume (Acre Feet)			
			10-Year	25-Year	50-Year	100-Year	10-Year	25-Year	50-Year	100-Year
South Block										
SB-1	687	74	12	23	36	52	3.53	6.61	10.45	14.95
SB-2	341	74	9	18	28	40	1.75	3.28	5.19	7.42
SB-3	329	74	7	13	21	30	1.69	3.17	5	7.16
SB-4	291	74	10	18	29	42	1.5	2.8	4.43	6.33
SB-5	448	74	14	26	40	58	2.3	4.31	6.81	9.75
SB-6	440	74	12	23	36	52	2.26	4.23	6.69	9.58
AA Block										
AA-1	1,290	68	4	13	25	41	1.45	4.38	8.7	14.25
AA-2	224	74	5	9	14	20	1.15	2.16	3.41	4.87
AA-3	1,046	68	4	11	23	37	1.18	3.55	7.05	11.55
AA-4	322	67	1	3	7	11	0.24	0.87	1.83	3.1
AA-5	304	73	7	13	21	30	1.29	2.53	4.11	5.98
Brush Crk	3,787					2,830				
North Block										
NB-1	472	74	14	26	41	59	2.43	4.54	7.18	10.27
NB-2	820	74	14	27	43	61	4.21	7.89	12.47	17.84
NB-2A	233	74	8	14	22	32	1.2	2.24	3.54	5.07
NB-2B	170	74	6	10	17	24	0.87	1.64	2.59	3.7
Bell Crk.	9,343		2,011			4,062				

in response to snowmelt or during the summer months in response to thunderstorm precipitation. The SCS Curve Number Method models runoff in response to a single precipitation event and, therefore, does not model streamflow response to snowmelt.

Average annual runoff was estimated utilizing a method developed by Riggs and Moore (1965). Regional runoff estimates for 1,000-foot elevation zones within the basin of interest (Rodeo Creek) were combined to obtain an estimate of mean annual runoff for the entire basin. The region containing the proposed Betze Project is expected to produce runoff only from those portions of the basin that are above 7,000 feet (Riggs and Moore 1965). Since only about three percent of the Rodeo Creek basin is above 7,000 feet, the estimated mean annual runoff is 0.5 cubic feet per second (cfs) (or approximately 360 acre-feet). Field and map observations suggest that the flow of Rodeo Creek infiltrates or evaporates before reaching Boulder Creek. It is probable that runoff from the higher elevations of the basin never reaches the basin outlet and that actual runoff may be highly variable from year to year. Runoff is likely to occur occasionally in response to extreme precipitation events or during unusually high spring runoff. Barrick personnel have observed the flow of Rodeo Creek extending to Boulder Creek for only a few weeks during the spring.

3.4.1.2 Surface Water Quality. The quality of surface water in the project area was characterized by grab samples from Rodeo Creek, Brush Creek, Bell Creek, Boulder Creek, and two surface impoundments. Table 3-7 summarizes the range of values obtained from analysis of samples collected from 1986 to 1989. Sampling was most intense at five sites along Rodeo Creek where flow is perennial. Samples were also collected near the mouths of Brush Creek and Bell Creek, at two sites on Boulder Creek downstream of the confluence with Rodeo Creek, and at two impoundments, the Bazza Pit and Pit Number 9. Data were reported by JBR Consultants Group (1989).

Surface water quality results are compared to Nevada drinking water standards in Table 3-7. Total dissolved solids (TDS) values do not exceed 423 milligrams per liter (mg/l) on the average. Maximum observed levels of arsenic, iron, lead, manganese, selenium, sulfate, total dissolved solids (TDS), and pH exceed the Nevada drinking water standards. Samples with pH

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Surface water quality results are compared to Nevada drinking water standards in Table 3-7. Total dissolved solids (TDS) values do not exceed 433 milligrams per liter (mg/l) on the average. Maximum observed levels of arsenic, iron, lead, manganese, selenium, sulfate, total dissolved solids (TDS), and pH exceed the Nevada drinking water standards. Samples with pH

TABLE 3-7

SURFACE WATER QUALITY DATA SUMMARY

Parameter	Number of Samples	Milligrams Per Liter			NV Drinking Water Standard
		Minimum	Mean	Maximum	
Alkalinity as $CaCO_3$	42	49.00	188.61	851.00	
Aluminum (T) as Al	43	0.01	0.31	1.80	
Ammonia as NH_3-N	55	0.10	0.39	7.50	
Arsenic (T) as As	159	0.01	0.07	1.40	0.05
Barium (T) as Ba	43	0.00	0.10	0.22	1.0
Bicarbonate as HCO_3	42	59.00	203.64	400.00	
Boron (T) as B	42	0.05	0.20	0.78	
Cadmium (T) as Cd	23	0.01	0.01	0.01	0.010
Calcium as Ca	105	6.20	42.91	270.00	
Carbonate as CO_3	41	0.00	6.49	26.00	
Chloride as Cl	42	3.20	33.31	102.00	400.0
Chromium (Hex) as Cr	22	0.01	0.01	0.02	
Chromium (T) as Cr	42	0.01	0.01	0.02	
Copper (T) as Cu	42	0.01	0.01	0.03	
Cyanide (T) as CN	92	0.002	0.01	0.04	0.02 (EPA)
Cyanide (Free) as CN	92	0.002	0.06	0.10	
Cyanide (WAD) as CN	53	0.01	0.01	0.02	
Fluoride as F	42	0.10	0.60	1.54	2.0
Gold as Au	93	0.01	0.01	0.05	
Hardness as $CaCO_3$	42	51.00	231.36	1,000.00	
Hardness (Non-Carb) as $CaCO_3$	23	0.00	28.35	348.00	
Hardness (T) as $CaCO_3$	23	110.00	224.83	473.00	
Hydroxide as OH	41	0.00	2.20	5.00	
Biological Oxygen Demand (BOB)	12	1.00	1.29	2.40	
Chemical Oxygen Demand (COD)	12	3.00	7.33	19.00	
Total Organic Carbon (TOC)		12	8.40	41.00	231.00
Iron (D) as Fe	90	0.01	0.04	0.35	
Iron (T) as Fe	109	0.01	1.67	32.80	0.6
Lead (T) as Pb	41	0.01	0.01	0.07	0.05
Magnesium as Mg	105	4.50	26.28	87.00	150.0
Manganese (T) as Mn	42	0.01	0.05	0.22	0.1

TABLE 3-7 (CONTINUED)

Parameter	Number of Samples	Milligrams Per Liter Minimum	Mean	Maximum	NV Drinking Water Standard
Mercury as Hg	109	0.00002	0.00022	0.002	0.002
Nickel (T) as Ni	42	0.01	0.01	0.07	
Nitrate as NO_3-N	55	0.01	0.55	8.20	10.0
Nitrite as NO_2-N	23	0.01	0.02	0.07	
Phosphate (Ortho) as PO_4-P	55	0.02	0.18	0.87	
Potassium as K	42	2.40	8.15	23.40	
Selenium (T) as Se	42	0.00	0.00	0.03	0.01
Silica (D) as SiO_2	23	20.60	38.78	54.00	
Silica (T) as SiO_2	18	0.50	14.51	21.00	
Silver (T) as Ag	42	0.01	0.01	0.05	0.05
Sodium as Na	109	7.30	52.15	139.00	
Sulfate as SO_4	42	6.40	115.13	1,100.00	500.0
Suspended Solids	131	0.01	174.57	14,000.00	
Thallium as Tl	42	0.01	0.01	0.01	
Total Dissolved Solids	42	107.00	423.02	1,900.00	1,000.0
Total Petroleum Hydrocarbons (TPH)	11	1.00	1.00	1.00	
Zinc (T) as Zn	42	0.01	0.04	0.30	5.0
Conductivity	165	140.00	637.95	2,700.00	
Settleable Solids	18	0.01	0.13	0.40	
Turbidity	131	0.05	47.74	1,500.00	
pH Units	167	3.32	8.29	10.00	6.5-8.5
Cations	24	0.00	6.47	13.96	
Anions	23	3.95	6.78	14.08	

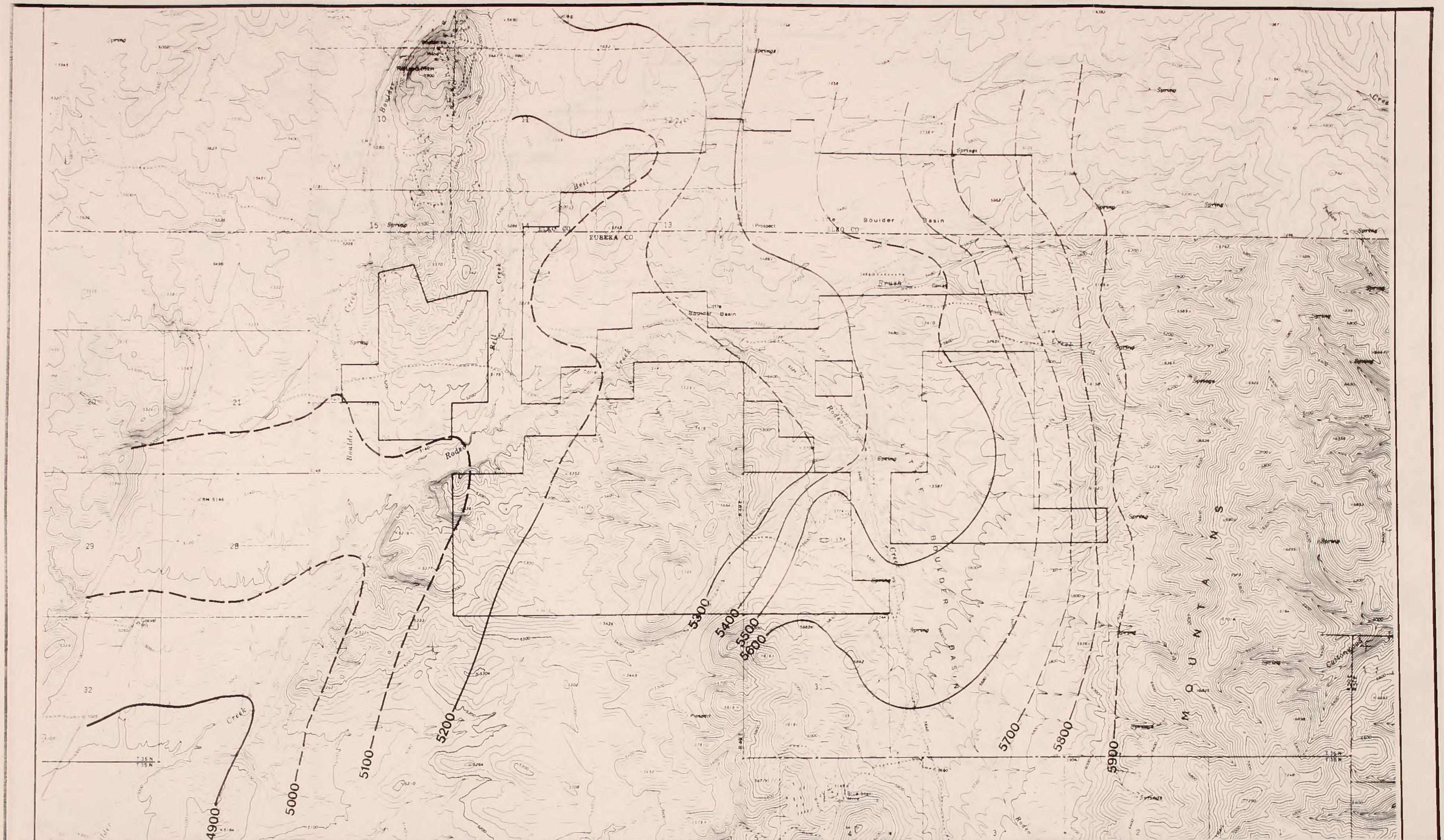
less than 5.0 occur at station RC-C on Rodeo Creek. The minimum observed pH of 3.32 is below the Nevada drinking water minimum standard of 6.5. These data reflect the existing condition at the project area. In general, surface waters are high in bicarbonate, carbonate, calcium, and have high alkalinity and pH.

A summary of water quality data for stations RC-A, RC-C, and Brush Creek is provided in Appendix B-2. RC-A is located on Rodeo Creek upstream of the proposed Betze Pit, and RC-C is located on Rodeo Creek downstream of the proposed project just below the confluence with Bell Creek. Brush Creek is tributary to Rodeo Creek from the northeast, and it is relatively unimpacted by mining with the exception of runoff from Newmont's Mill No. 4. A comparison of water quality data from these stations provides insight into the present impacts on Rodeo Creek.

Station RC-C has higher average levels of alkalinity, bicarbonate, iron, sulfate, total suspended solids, total dissolved solids, and turbidity than station RC-A. The most significant observed increases occur for iron (2 orders of magnitude), total suspended solids (TSS) (3 orders of magnitude), TDS (2 fold), and turbidity (1 order of magnitude). Levels of arsenic are approximately the same at the two stations on Rodeo Creek, but the levels are on order of magnitude greater than the mean value for Brush Creek. The mean value of pH for all three stations is approximately the same. The levels of iron, sulfate, TSS, and TDS are similar for Brush Creek and for station RC-A. This suggests that the present mining activity at the project site is contributing additional constituents to the surface water, especially suspended sediment. The increase in iron, TDS, and sulfate may also be related to concentration due to evaporation.

3.4.2 Groundwater

Data from mineral exploration drilling provide the majority of the information used to define the groundwater levels within the project area. Figure 3-5 shows a compilation of geologic maps for the project area. Groundwater elevations from several previous environmental assessments (BLM 1988c, 1988d, 1989a, 1989b; and Barrick Goldstrike 1989) are compiled on a single map (Figure 3-6) to show the direction and gradient of groundwater flow within the project area. Generally, groundwater flow follows topography moving from the northeast side of the project area to the southwest. South of the proposed pit, a groundwater mound is



5300 ——— - - - - GROUNDWATER ELEVATION CONTOUR (Dashed where inferred.)

0 1 miles

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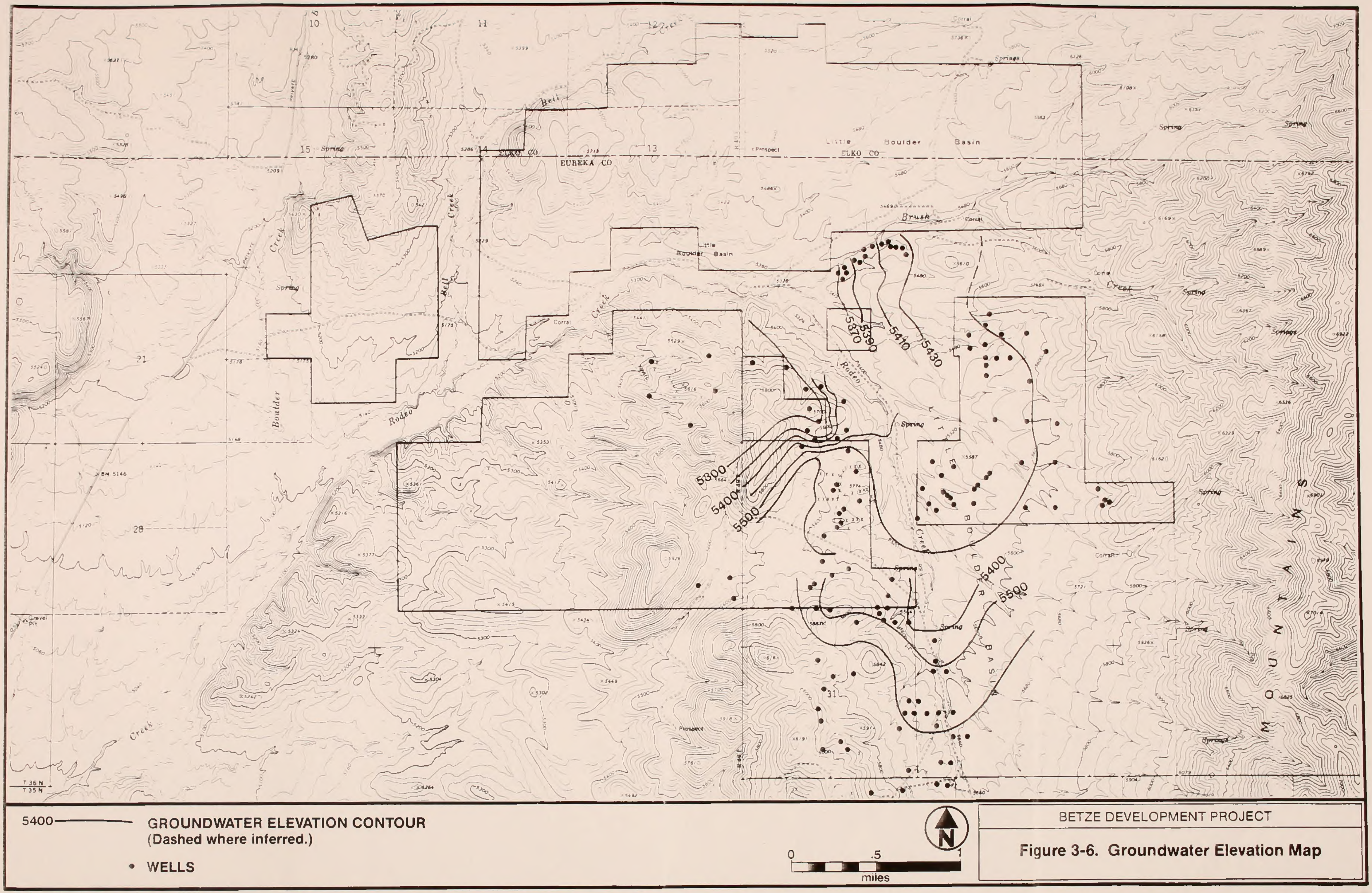
BETZE DEVELOPMENT PROJECT

Figure 3-5. Regional Hydrologic Map



BETZE DEVELOPMENT PROJECT

Figure 3-6. Groundwater Elevation Map

associated with the granodiorite stock which is less permeable than other formations within the project area.

Recharge generally occurs in the central and eastern portions of the project area. Groundwater discharges at several springs within the Rodeo Creek and Bell Creek drainages. Both creeks maintain perennial flow for several miles downstream of the springs until they infiltrate and recharge the alluvial aquifers adjacent to the creeks. The regional groundwater system discharges to the southwest into the aquifers underlying Boulder Valley. High water temperatures are observed in deep wells in the vicinity of the Betze Pit that may be related to upward migration of warm waters through the fracture system related to the Carlin Trend mineralization (Papadopulos & Associates 1988). For the purpose of this analysis the recharge from deep sources was not considered to be significant.

3.4.2.1 Hydrogeologic Conditions. Groundwater in the project area occurs within shallow alluvium, the Carlin Formation, Paleozoic metasediments, and the granodiorite stock. The Paleozoic metasediments are split into two major groups, called the upper plate and lower plate, based upon the relationship of each group to the Roberts Mountain Thrust Fault (BLM 1988b).

Shallow alluvial deposits are found adjacent to the major creeks running through the project area. Major drainage within these deposits follows the course of Rodeo Creek, which flows north on the east side of the project area, and then westerly around the north end of the project area to Boulder Creek which flows southwesterly into the Humboldt River. Alluvium generally consists of interbedded clay, silt, sand, and gravel deposited by channel and overbank flows of the creek. Permeability of the alluvium ranges from 1.0×10^{-4} cm/sec to 8.0×10^{-2} cm/sec (Newmont 1988). There is usually direct hydraulic communication between water in the alluvium and any surface flow in streams. There is also hydraulic communication between water in the alluvium and the underlying bedrock formations.

The Tertiary Carlin Formation is found east of Rodeo Creek (BLM 1988b and 1988c) underlying Little Boulder Basin. The formation is up to 600 feet thick and consists of a complex of sandy tufaceous silts, shales, and conglomerates (BLM 1988c). The variable nature of the formation produces

associated with the granodiorite stock which is less permeable than other formations within the project area.

Recharge generally occurs in the central and western portions of the project area. Groundwater discharges at several springs within the Rodeo Creek and Bell Creek drainages. Both creeks maintain perennial flow for several miles downstream of the springs until they infiltrate and recharge the alluvial aquifers adjacent to the creeks. The regional groundwater system discharges to the southeast into the aquifers underlying Boulder Valley. High water temperatures are observed in deep wells in the vicinity of the Betze Pit that may be related to upward migration of warm waters through the fracture system related to the Carlin Trend mineralization (Papadopulos & Associates 1989). For the purpose of this analysis the recharge from deep sources was not considered to be significant.

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Shallow alluvial deposits are found adjacent to the major creeks running through the project area. Major drainage within these deposits follows the course of Rodeo Creek, which flows north on the east side of the project area, and then westerly around the north end of the project area to Boulder Creek which flows southwesterly into the Humboldt River. Alluvium generally consists of interbedded clay, silt, sand, and gravel deposited by channel and overbank flows of the creek. Permeability of the alluvium ranges from 1.0×10^{-4} cm/sec to 5.0×10^{-2} cm/sec (Newmont 1988). There is usually direct hydraulic communication between water in the alluvium and any surface flow in streams. There is also hydraulic communication between water in the alluvium and the underlying bedrock formations.

The Tertiary Carlin Formation is found east of Rodeo Creek (BLM 1988b and 1988c) underlying Little Boulder Basin. The formation is up to 800 feet thick and consists of a complex of sandy tuffaceous silts, shales, and conglomerates (BLM 1988c). The variable nature of the formation produces

zones of permeable material, which yield water to pumped boreholes, interbedded with relatively impermeable material which retards the flow of water and locally confines the underlying permeable zones (BLM 1988c). Flow is generally from east to west following the permeable zones along the bedding planes within the formation. Very little vertical flow occurs and, in fact, it appears that the Carlin Formation acts as an aquitard producing locally confined conditions within the underlying metasediments (BLM 1988b). This is demonstrated by the fact that a well drilled by Newmont through the Carlin Formation into the underlying metasediments produced artisan flow conditions (BLM 1988d). Permeability of the Carlin Formation ranges from 6.0 x 10^{-7} cm/sec to 2.4 x 10^{-4} cm/sec (BLM 1988d). Most of the recharge of the Carlin Formation probably derives from direct infiltration of precipitation and snowmelt with lesser amounts from the underlying metasediments.

The topographic high south and west of Rodeo Creek and east of Boulder Creek is underlain by the Paleozoic metasediments (upper and lower plate) and the Cretaceous granodiorite. The proposed Betze Pit would be located predominantly within the metasediments and to a lesser extent within the granodiorite. The upper plate rocks which are host to the oxide mineral deposits of the Post Pit consist primarily of siltstone, limestone, argillite, and quartzite (BLM 1988b). The lower plate rocks are composed of carbonaceous meta-limestones and dolomites that host the sulfide deposits of the Betze Pit. Both the upper and lower plate rocks have been extensively fractured and altered producing a highly variable secondary porosity and permeability (BLM 1988b). Long-term pump tests in the upper plate rocks (Barrick 1988b) indicate the bulk permeability is about 2.4 x 10^{-4} cm/sec and the apparent storativity ranges from 0.003 to 0.004. The lower plate rocks are thought to be less permeable than the upper plate rocks (BLM 1988b), although no pump tests have been conducted within these rocks. Groundwater elevations within the metasediments in the vicinity of the Post Pit are about 5,300 feet (BLM 1988b).

The major fault system within the metasediments trends from the northwest to the southeast and dips to the north. Minor fault systems trend north-south and northeast to southwest. The Post Fault, located on the east side of the proposed Betze Pit, is thought to act as a no-flow boundary (flow barrier) (Papadopulos & Associates 1988). However, the existing mining operation has mined through the fault exposing the fault

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The major fault system within the metasediments trends from the northwest to the southeast and dips to the north. Minor fault systems trend north-south and northeast to southwest. The Post Fault, located on the east side of the proposed Betze Pit, is thought to act as a no-flow boundary (flow barrier) (Hydro-Search & Associates 1988). However, the existing mining operation has mined through the fault exposing the fault

trace in the eastern walls of the Post Pit. Thermal (110° - 130°F) waters observed at depths of 800 to 1,200 feet probably migrate upward along the major fault system which is also associated with higher than normal well yields. Recharge of the metasediments probably occurs from infiltration of direct precipitation and snowmelt. Deeper portions of the metasediment aquifer may also be recharged by east-west flow under the project area (Barrick 1988b).

A Cretaceous granodiorite stock is intruded into the metasediments at the southeast corner of the proposed Betze Pit. Preliminary hydrologic analysis indicates that the contact between the granodiorite and the metasediments is highly altered and may act as a no-flow boundary (BLM 1988b). The mound in the groundwater elevations suggests that the granodiorite has a lower permeability than the surrounding metasediments. The gradient of the groundwater surface to the east and northeast from the granodiorite indicates groundwater flows toward Little Boulder Basin and discharges into Rodeo Creek. The groundwater elevation in the granodiorite averages 5,500 to 5,600 feet (BLM 1988b).

Little is known about the groundwater conditions west of the project area in Boulder Valley due to a limited amount of drillhole data. Drill logs suggest the valley is underlain by a thin veneer of alluvium overlying the Carlin Formation. Groundwater conditions are likely similar to those in Little Boulder Basin east of Rodeo Creek except there are no springs discharging into the area, and Boulder Creek is ephemeral along the valley. Groundwater flow within the recent alluvium follows Boulder Valley and is tributary to the Humboldt River hydrologic system (Harrill et al. 1988). Groundwater levels are over 100 feet deep in two wells located about 1.5 miles downstream from the confluence of Boulder Creek and Rodeo Creek (Kiracofe 1990). Water levels in the recent alluvium along Boulder Creek rise to within 10 to 25 feet of the surface in the lower reaches of Boulder Valley (Thomas et al. 1986).

3.4.2.2 <u>Groundwater Quality</u>. The quality of subsurface water was determined by analysis of water samples from exploration drillholes. Table 3-8 summarizes the results of groundwater quality analyses and compares them to Nevada drinking water standards. Locations of drillholes from which samples were taken are shown on Figure 3-4. The water has an average total dissolved solids (TDS) values of 469 mg/l. Deep drilling in

zones in the eastern walls of the East Pit. Thermal (119° - 190°F) water, observed at depths of 800 to 1,300 feet probably migrate upward along the major fault system which is also associated with higher than normal well yields. Recharge of the metasediments probably occurs from infiltration of direct precipitation and snowmelt. Deeper portions of the metasediment aquifer may also be recharged by east-west flow under the project area (Harrill 1989a).

A Cretaceous granodiorite stock is intruded into the metasediments at the southeast corner of the proposed Betze Pit. Preliminary hydrologic analysis indicates that the contact between the granodiorite and the metasediments is highly altered and may act as a no-flow boundary (BLM 1989h). The mound in the groundwater elevations suggests that the granodiorite has a lower permeability than the surrounding metasediments. The gradient of the groundwater surface to the east and northeast from the granodiorite indicates groundwater flows toward Little Boulder Basin and discharges into Rodeo Creek. The groundwater elevation in the granodiorite averages 5,500 to 5,700 feet (BLM 1989h).

Little is known about the groundwater conditions west of the project area in Boulder Valley due to a limited amount of drillhole data. Drill logs suggest the valley is underlain by a thin veneer of alluvium overlying the Carlin Formation. Groundwater conditions are likely similar to those in Little Boulder Basin east of Rodeo Creek except there are no springs discharging into the area, and Boulder Creek is ephemeral along the valley. Groundwater flow within the recent alluvium follows Boulder Valley and is tributary to the Humboldt River hydrologic system (Harrill et al. 1988). Groundwater levels are over 100 feet deep in two wells located about 1.5 miles downstream from the confluence of Boulder Creek and Rodeo Creek (Eakin 1961). Water levels in the recent alluvium along Boulder Creek rise to within 10 to 25 feet of the surface in the lower reaches of Boulder Valley (Thomas et al. 1986).

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TABLE 3-8

GROUNDWATER QUALITY DATA SUMMARY

Parameter	Number of Samples	Milligrams Per Liter			NV Drinking Water Standard
		Minimum	Mean	Maximum	
Alkalinity as $CaCO_3$	96	99.00	242.55	520.00	
Aluminum (T) as Al	95	0.01	1.83	40.00	
Ammonia as NH_3-N	95	0.02	0.58	4.07	
Arsenic (T) as As	134	0.01	0.24	7.26	0.05
Barium (T) as Ba	96	0.01	0.17	1.10	1.0
Bicarbonate as HCO_3	96	30.00	290.26	630.00	
Boron (T) as B	95	0.05	0.43	1.10	
Cadmium (T) as Cd	49	0.01	0.01	0.01	0.010
Calcium as Ca	96	7.00	58.07	113.00	
Carbonate as CO_3	96	0.00	4.20	93.00	400.0
Chloride as Cl	96	10.10	28.96	95.00	
Chromium (Hex) as Cr	49	0.01	0.01	0.02	
Chromium (T) as Cr	95	0.00	0.01	0.24	0.05
Copper (T) as Cu	96	0.01	0.04	0.81	1.0
Cyanide (T) as CN	134	0.002	0.07	6.40	
Cyanide (Free) as CN	132	0.002	0.09	4.70	
Cyanide (WAD) as CN	70	0.01	0.05	2.30	
Fluoride as F	96	0.05	0.99	2.30	2.0
Gold as Au	129	0.01	0.01	0.05	
Hardness as $CaCO_3$	95	82.00	244.60	379.00	
Hardness (Non-Carb) as $CaCO_3$	49	0.00	38.12	293.00	
Hardness (T) as $CaCO_3$	49	0.00	227.53	390.00	
Hydroxide as OH	95	0.00	2.42	5.00	
Iron (D) as Fe	49	0.01	0.10	0.80	
Iron (T) as Fe	95	0.01	2.30	34.00	0.6
Lead (T) as Pb	96	0.01	0.02	0.25	0.05
Magnesium as Mg	96	4.80	22.20	42.20	150.0
Manganese (T) as Mn	96	0.00	0.12	2.31	0.1
Mercury as Hg	96	0.0001	0.0002	0.0017	0.002
Nickel (T) as Ni	96	0.01	0.02	0.13	
Nitrate as NO_3-N	96	0.01	0.86	9.17	10.0

TABLE 3-8 (CONTINUED)

Parameter	Number of Samples	Milligrams Per Liter Minimum	Milligrams Per Liter Mean	Milligrams Per Liter Maximum	NV Drinking Water Standard
Nitrite as NO_2-N	49	0.01	0.05	1.01	
Phosphate (Ortho) as PO_4-P	95	0.01	0.13	1.34	
Potassium as K	95	2.40	13.41	31.20	
Selenium (T) as Se	96	0.002	0.004	0.03	0.01
Silica (D) as SiO_2	49	13.10	32.14	53.40	
Silica (T-ICP) as SiO_2	46	8.30	20.77	49.00	
Silver (T) as Ag	95	0.01	0.01	0.09	0.05
Sodium as Na	95	22.80	56.28	120.00	
Sulfate as SO_4	96	2.90	95.46	393.00	500.0
Suspended Solids	95	1.00	246.16	4,230.00	
Thallium as Tl	95	0.01	0.01	0.01	
Total Dissolved Solids	96	228.00	468.84	1,000.00	1,000.0
Zinc (T) as Zn	96	0.01	0.08	1.18	5.0
Conductivity	128	363.0	716.8	5,000.0	
Settleable Solids	45	0.1	0.4	5.0	
Turbidity	94	0.2	32.0	550.0	
pH Units	129	6.5	7.7	9.8	6.5-8.5
Cations	49	2.71	7.11	12.15	
Anions	49	2.85	7.16	12.35	

the vicinity of the proposed Betze Pit encountered thermal waters with temperatures as high as 130°F (Papadopulos & Associates 1988).

Groundwater quality reflects the chemistry of the rocks through which it flows. In this case the area is predominantly underlain by limestones and dolomites with minor amounts of volcanic-derived fluvial deposits. The water is generally high in bicarbonate or carbonate and calcium, and it has a moderately high alkalinity. The pH averages 7.7 with a standard deviation of 0.5. With the exception of elevated levels of arsenic, the groundwater is generally of good quality and may be classified as a calcium-bicarbonate type.

Cyanide levels greater than 0.2 mg/l were found in two samples from station GWOP-6, an observation well near the heap leach facility. High levels of dissolved solids were found in samples from well BW-1. Values of pH below 7.0 were found in the Bazza Well, BW-1, AA Well, GWOP-2, GWOP-4, GWOP-6, GWOP-11, and WW-1. Relatively high levels of dissolved solids (above 600 mg/l) were found in the Bazza Pit, Bazza Well, GWOP-2, GWOP-6, and PPW#6.

Summary data for selected groundwater wells is provided in Appendix B-3. A comparison of data from pumping wells (BW-1, PUPW-2, P-181, PPW-1, PPW-2, PPW-3, PPW-4, PPW-5, and PPW-6) with data from observation wells (GWOP-2, GWOP-4, GWOP-5, GWOP-6, GWOP-10, and GWOP-11) provides insight into the water chemistry of groundwater in the Paleozoic metasediments and the Carlin Formation. In general, water within the Paleozoic metasediments is higher in arsenic, alkalinity, and bicarbonate than the Carlin Formation. The levels of iron, TSS, and turbidity are higher on the average in the Carlin Formation than in the Paleozoic metasediments. High TSS and turbidity are probably related to the fine-grained nature of the sediments within the Carlin Formation.

3.4.3 Water Rights

Information on water rights within the project area was obtained by computer search of files at the Nevada State Engineer's Office. Within the Boulder Flat Hydrographic Area there are 58 filings for irrigation water rights, 45 mining and milling rights, 35 stock watering rights, and 4 domestic wells. The mining and milling wells are located along the upper reaches of Boulder Creek and Rodeo Creek where most of the active mining is taking place. The irrigation and stock watering wells are scattered

the vicinity of the proposed Relief Pit encountered thermal waters with temperatures as high as 150°F (Hydrogeologic & Associates 1988).

Groundwater quality reflects the chemistry of the rocks through which it flows. In this case the area is predominantly underlain by limestones and dolomites with minor amounts of volcanic-derived fluvial deposits. The water is generally high in bicarbonate or carbonate and calcium, and it has a moderately high alkalinity. The pH averages 7.7 with a standard deviation of 0.5. With the exception of elevated levels of arsenic, the groundwater is generally of good quality and may be classified as a calcium-bicarbonate type.

Cyanide levels greater than 0.2 mg/l were found in two samples from station GWOP-6, an observation well near the heap leach facility. High levels of dissolved solids were found in samples from well SM-1. Values of pH below 7.0 were found in the Mexie Well, SM-1, AA Well, GWOP-2, GWOP-4, GWOP-6, GWOP-11, and PW-1. Relatively high levels of dissolved solids (above 500 mg/l) were found in the Mexie Pit, Mexie Well, GWOP-2, GWOP-6, and GWOP-___.

Summary data for selected groundwater wells is provided in Appendix ___. A comparison of data from pumping wells (BM-1, FGPW-2, F-1(?), STW-1, PPW-1, PPW-2, BPW-2, PPW-5, and PPW-6) with data from observation wells (GWOP-2, GWOP-4, GWOP-5, GWOP-6, GWOP-10, and GWOP-11) provides insight into the water chemistry of groundwater in the Paleozoic metasediments and the Carlin Formation. In general, water within the Paleozoic metasediments is higher in arsenic, alkalinity, and bicarbonate than the Carlin Formation. The levels of iron, TSS, and turbidity are higher on the average in the Carlin Formation than in the Paleozoic metasediments. High TSS and turbidity are probably related to the fine-grained nature of the sediments within the Carlin Formation.

3.4.3 Water Rights

Information on water rights within the project area was obtained by computer search of files at the Nevada State Engineer's Office. Within the Boulder Flat Hydrographic Area there are 59 filings for irrigation water rights, 45 mining and milling rights, 35 stock watering rights, and 4 domestic wells. The mining and milling wells are located along the upper reaches of Boulder Creek and Brush Creek where most of the active mining is taking place. The irrigation and stock watering wells are scattered

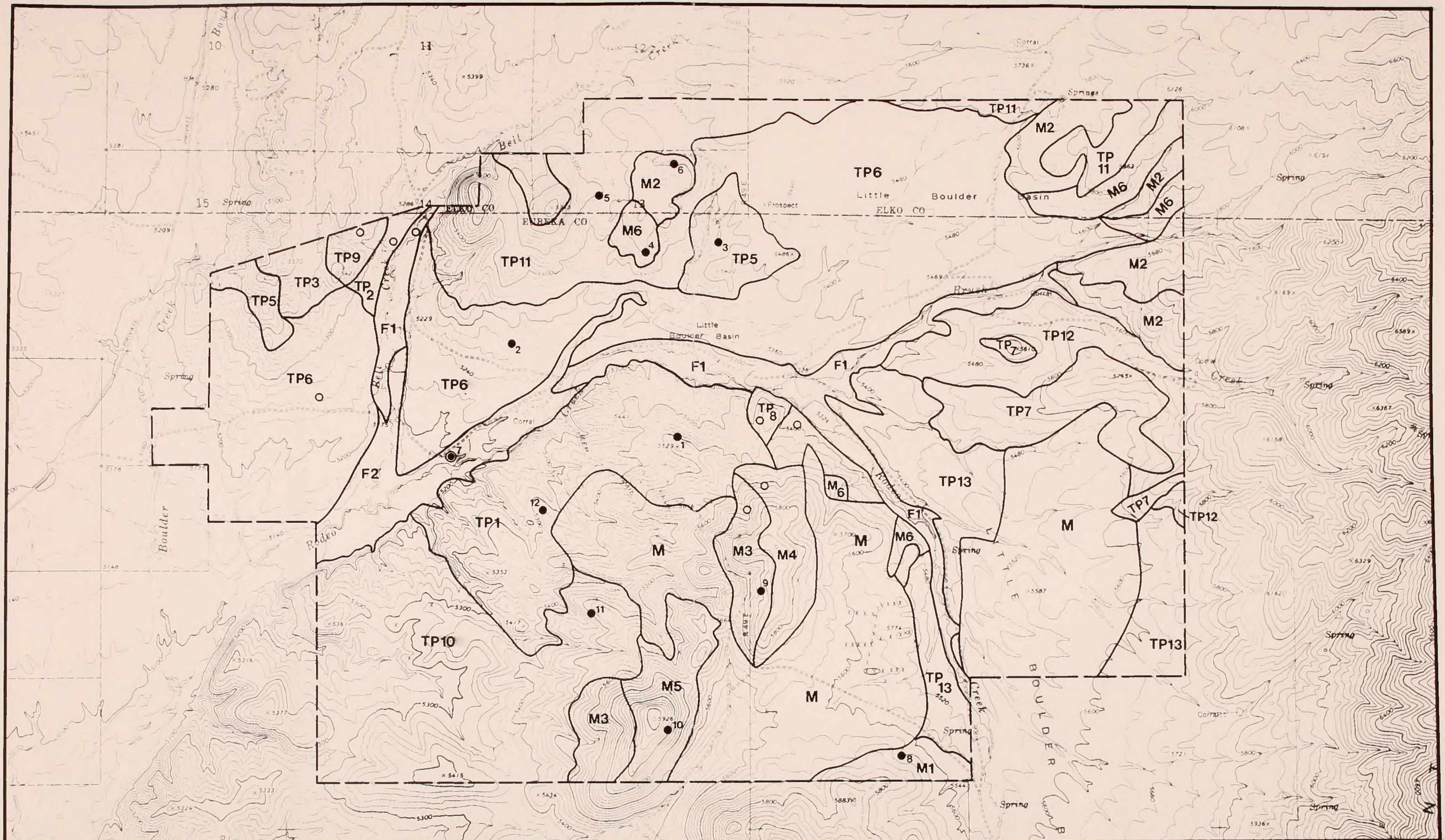
throughout Boulder Valley. Within a 4-mile radius of the proposed Betze Pit there are 24 mining and milling wells, 2 stock watering wells, and 1 irrigation well. By expanding to a 10-mile radius, an additional 7 mining and milling wells, 8 stock watering wells, and 13 irrigation wells are included. Virtually all filed water rights are for underground sources of water. Several early rights were filed for spring and stream sources, several of which are located on Boulder Creek.

3.5 Soils

Detailed soil mapping and sampling of the study area was conducted in 1988 (BLM 1989c). This Order II soil survey covered approximately 8,169 acres and included sampling for laboratory analysis of 14 of the 20 soils mapped in the study area. Eight of the 20 mapped soils were established SCS soil series; the remainder were new soils identified during the study. Two small areas, the southeast corner of AA Block and the northern extension of North Block, were not included in the survey. The SCS Order III Tuscarora Mountain soil survey information was used for these areas. The soils map of the study area is presented as Figure 3-7.

Of the 20 soils, 19 were mapped as individual map units (one soil type per map unit); as such, soil descriptions but not map unit descriptions were described in the report. Table 3-9 provides soil data and interpretation for these soils.

The Little Boulder Basin study area terrain is typical of the Basin and Range physiographic province. The north-south trending fault-block mountain ranges expose sedimentary rocks of Paleozoic age in northern Eureka County. These rocks typically include siltstone, argillite, quartzite, limestone, shale, and chert of the Ordovician Vinini Formation and have been locally intruded by igneous stocks, dikes, and veins. At lower elevations adjacent to the rock outcrops, the Paleozoic rocks are mantled by Tertiary sandy tuffaceous siltstones and conglomerates of the Carlin Formation. Unconsolidated Quaternary alluvium, of various thickness, is found in valleys. The interbedded nature of the bedrock, combined with the greatly varying intensity of rock deformation and alteration, has produced a great variety of weathering effects and therefore a wide variety of soil types.



● ENSR (BG) SAMPLE SITE (with JBR)
○ JBR SAMPLE ONLY
◉ ENSR (BG) SAMPLE ONLY

TP1–SOIL UNIT SYMBOL
FOR EXPLANATION OF SYMBOLS, SEE TABLE 3.3A.

0 1000' 2000' ½ mi.

BETZE DEVELOPMENT PROJECT

Figure 3-7. Soils Map

TABLE 3-9

SOIL CHARACTERISTICS AND INTERPRETATIONS

Map Unit Symbol	Soil Name	Landform	Slopes (%)	Parent Material	Soil Depth (in.)	Soil Texture	Erosion Hazard	Range Site	Salvageable Topsoil Depth (inches)	Topsoil Quality
M1	Blue Star	mountain slopes	10-30	siltstones, argillites	46	gravelly sandy clay loams	moderate	25-12	30	Good
M2	Brushcreek	mountain slopes	15-30	igneous rocks	35	clay loams	moderate	25-12	20	Fair
M3	Long Lac	mountain slopes	15-30	carbonate rocks, quartzites, argillites, siltstones	29	gravelly clay loams	moderate	24-5 25-19	18	Good
M4	Post	mountain slopes	10-30	carbonate rocks, quartzites, argillites, siltstones	29	sandy loams to clay loams	moderate	24-5 25-19	29	Good
M5	Post, rocky variant	mountain slopes	10-30	carbonate rocks, quartzites, argillites, siltstones	32	sandy clay loams	moderate	24-5 25-19	30 lower slopes, 17 ridges	Good
M6	Shortcreek[1]	terrace slopes	15-50	quartzites	60	very gravelly clay loams	moderate to severe	25-14	20	Fair
TP1	Bazza	piedmont	5-15	residuum and colluvium of limestone and chert	40	clay loams	moderate to slight	25-19	24	Fair
TP2	Bell	alluvial fan	4-8	limestone alluvium	26	loam and clay loams	slight	25-21	12	Poor
TP3	Bootstrap	slopes	8-30	shales	12	gravelly loams	slight to moderate	25-21	12	Poor
TP4	Boulflat[1]	hill slopes	10-30	residum and colluvium of chert, quartzite and silt	34	gravelly loams	moderate	25-19	13	Poor
TP5	Clyesdales	terrace	4-15	mixed colluvium and alluvium	14	gravelly clay loams	slight	25-19	7	Poor
TP6	Cortez[1]	fan slopes	4-15	mixed alluvium	31	loam to clay loams	slight	25-19	12	Poor
TP7	Donna[1]	piedmont	4-15	tuffaceous sediments	26	clay loams	slight	25-18	10	Fair
TP8	Havingdon[1]	foothills	15-30	residuum of chert, shale, and silt	21	silt loams	moderate	25-19	10	Fair
TP9	Rabbit	hill slopes	8-30	residuum from limestone	10	clay loams	slight	25-21	10	Poor

TABLE 3-9 (CONTINUED)

Map Unit Symbol	Soil Name	Landform	Slopes (%)	Parent Material	Soil Depth (in.)	Soil Texture	Erosion Hazard	Range Site	Salvageable Topsoil Depth (inches)	Topsoil Quality
TP10	Ramires[1]	piedmont	4–15	tuffaceous sediments	34	clay loams	slight	25–19	14	Poor
TP11	Sagehill	mountain slopes	0–8	quartzite	18	gravelly loam to clays	slight	25–19	8	Poor
TP12	Stampede[1]	hill slopes	4–15	tuffaceous sediments	38	clay loams	slight	25–14	8	Fair
TP13	Stampede–Donna	See Stampede (TP12) and Donna (TP7) descriptions.								
F1	Welch[1]	floodplains	2–8	mixed alluvium	60+	loams to clay loams	slight	25–3	60+	Good
F2	Welch, drained	floodplains	0–4	mixed alluvium	60+	silt loams	slight	25–3E	60+	Good

[1]These soils are official Soil Conservation Service (SCS) soil series. The other soils were identified specifically for the Betze Project.

Soils have been grouped as: 1) mountain soils, 2) terrace and piedmont slope soils, and 3) floodplain soils. The mountain soils include Blue Star, Brushcreek, Long Lac, Post, Post-rocky variant, and Shortcreek. These soils consist of deep, well drained, moderately permeable soils on ridges and upper slopes of the mountains. Parent materials are residuum and colluvium derived from a variety of rock types including limestones, siltstones, and argillites. Soil depth varies greatly depending on rock type and degree of weathering and alteration. Soil can be salvaged until the underlying C horizon substratum is encountered. This depth ranges from 17 to 30 inches across the study area.

Terrace and piedmont slope soils include Bazza, Bell, Bootstrap, Boulflat, Clydesdales, Cortez, Donna, Havingdon, Rabbit, Ramires, Sagehill, and Stampede. These soils are derived from colluvium and alluvium, and in some cases residuum. Soil depth varies greatly, but is usually less deep than for soils on the mountain slopes. Many of these soils have indurated hardpans that limit topsoil salvage. Soil salvage depth ranges from 8 to 24 inches depending on soil type. The soils are derived from tuffaceous sediments.

Floodplain soils include Welch and Welch-drained. These soils are derived from mixed alluvial materials. Both soils are often very deep, greater than 60 inches, and have stratified layers of variable texture. The entrenchment of stream channels has lowered the water table, changing the vegetation from meadows to large shrub communities. These soils can provide large quantities of good topsoil material, with salvage depths ranging from 5 to 15 feet. However, mine plan objectives include nondisturbance of stream channels, where possible.

A Disturbed Land map unit contains areas previously disturbed by mining and associated activities. No topsoil material is available from these areas.

In summary, soil suitability evaluations indicate that all soils have suitable topsoil in the upper portions of the soil profiles. The underlying C horizon substratum is not recommended for salvage. Soil material on terraces and piedmont slopes cannot be salvaged once the indurated hardpans are encountered.

Soils have been grouped as: 1) mountain soils, 2) terraces a
piedmont slope soils, and 3) floodplain soils. The mountain soils inclu
Gold Bond, Greenhorn, Long Lac, Poet, Poet-rocky variant, and Shortcree
These soils consist of deep, well drained, moderately permeable soils
ridges and upper slopes of the mountains. Parent materials are residu
and colluvium derived from a variety of rock types including limestone
siltstones, and argillites. Soil depth varies greatly depending on ro
type and degree of weathering and alteration. Soil can be salvaged unt
the underlying C horizon substratum is encountered. This depth ranges fr
17 to 30 inches across the study area.

Terraces and piedmont slope soils include Barns, Bell, Bootstra
woodflat, Hilgerstone, Cerveny, Ipsma, Bavington, Rabbit, Ramliss, Rogevil
and Stemple. These soils are derived from colluvium and alluvium, and
some cases residuum. Soil depth varies greatly, but is usually less de
than for soils on the mountain slopes. Many of these soils have indurat
hardpans that limit topsoil salvage. Soil salvage depth ranges from 8
24 inches depending on soil type. The soils are derived from calcareo
sediments.

Floodplain soils include Welch and Welch-drained. These soils a
derived from mixed alluvial materials. Both soils are often very dee
(greater than 60 inches), and have stratified layers of variable textur
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indurated hardpans are encountered.

3.6 Vegetation

The combination of topography and a mid-latitude steppe climate has produced grass and shrub dominated vegetation in Little Boulder Basin. Disturbances to the vegetation such as overgrazing, large-scale range fires of the 1960s, past and present mining operations, and mineral exploration, along with subsequent BLM rehabilitation efforts, have converted much of the area from indigenous vegetation of sagebrush-grass to seeded exotic grasses, sagebrush, and annuals. Baseline vegetation studies were performed on the project area from April to June (JBR Consultants Group 1989a). The following discussion was developed from several sources, including: JBR Consultants Group 1989a; BLM 1987a; BLM 1988a; BLM 1988b.

3.6.1 Vegetation Communities

The vegetation communities within the project area have been grouped into four types which are described below. None of the 4 types are climax communities, but are successional stages. Table 3-10 summarizes the vegetation types, composition, and dominant species. Figure 3-8 is a vegetation map of the project area.

3.6.1.1 Sagebrush-Unburned. This community type represents the dominant pre-fire plant community common to the area and covers 207 acres of the claim blocks. It currently exists as small remnants on the dry, unburned north slopes and on portions of the foothills of the main Tuscarora Range that were outside of the burned areas.

The vegetative cover in this community averages approximately 45 to 62 percent. Basin big sagebrush (Artemisia tridentata ssp. tridentata) comprises 71 percent of the community and cheatgrass (Bromus tectorum) occurs in the small disturbed sites (JBR Consultants Group 1989).

3.6.1.2 Burned. This community type consists of areas that were burned or partially burned and variously seeded, never seeded, or seeded unsuccessfully. Consequently, the composition, cover, and productivity of this type varies widely. It covers 4,704 acres of the claim blocks. The following discussions describe four general communities that comprise this type.

3.6 Vegetation

The combination of topography and a mid-latitude steppe climate has produced grass and shrub dominated vegetation in Little Boulder Basin. Disturbances to the vegetation such as overgrazing, large-scale range fires of the 1960s, past and present mining operations, and mineral exploration, along with subsequent BLM rehabilitation efforts, have converted much of the area from indigenous vegetation of sagebrush-grass to seeded exotic grasses, sagebrush, and annuals. Baseline vegetation studies were performed on the project area from April to June (JBR Consultants Group 1989). The following discussion was developed from several sources, including: JBR Consultants Group 1989a; BLM 1987a; BLM 1988a; BLM 1989b.

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The vegetation communities within the project area have been grouped into four types which are described below. None of the 4 types are climax communities, but are successional stages. Table 3-10 summarizes the vegetation types, composition, and dominant species. Figure 3-8 is a vegetation map of the project area.

3.6.1.1 Sagebrush-Unburned. This community type represents the dominant pre-fire plant community common to the area and covers 297 acres of the claim blocks. It currently exists as small remnants on the dry, exposed north slopes and on portions of the foothills of the main Tuscarora Range that were outside of the burned areas.

The vegetative cover in this community averages approximately 45 to 48 percent. Basin big sagebrush (Artemisia tridentata ssp. tridentata) comprises 72 percent of the community and cheatgrass (Bromus tectorum) occurs in the small disturbed sites (JBR Consultants Group 1989).

3.6.1.2 Burned. This community type consists of areas that were burned or partially burned and variously seeded, never seeded, or seeded unsuccessfully. Consequently, the composition, cover, and productivity of this type varies widely. It covers 4,784 acres of the claim blocks. The following discussions describe four general communities that comprise this type.

TABLE 3-10

SPECIES COMPOSITION AMONG VEGETATION TYPES

Common Name	Scientific Name	Vegetation Type[1] SU	SB	FP	ML
Grasses and Forbs					
crested wheatgrass	*Agropyron cristatum*		D	X	
thickspike wheatgrass	*Agropyron dasystachyum*			X	
western wheatgrass	*Agropyron smithii*		X		
bluebunch wheatgrass	*Agropyron spicatum*	X	X		
milkvetch	*Astragalus* sp.		X		
Hooker balsamroot	*Balsamorhiza hookeri*	X	X		
cheatgrass	*Bromus tectorum*	X	D	X	
daisy	*Erigeron* sp.		X		
basin wildrye	*Elymus cinereus*	X	X	X	
buckwheat	*Eriogonum* sp.		X		
filaree	*Erodium cicutarium*		X		
tailcup lupine	*Lupinus* sp.	X	X		
Sandberg bluegrass	*Poa secunda*	X	X	X	
bottlebush squirreltail	*Sitanion hystrix*	X	X		
other forbs			X	X	
Shrubs					
basin big sagebrush	Artemisia tridentata ssp. tridentata	D	D	D	
rubber rabbitbrush	Chrysothamnus nauseosus		X	X	
Douglas rabbitbrush	Chrysothamnus viscidiflorus	X	X		
phlox	Phlox sp.		X		

D = Dominant species within the study area

[1] SU = Sagebrush Unburned
SB = Sagebrush - Burned, Burned/Seeded, Burned/Non-seeded, Partially Burned
FP = Floodplains
ML = Mined Lands

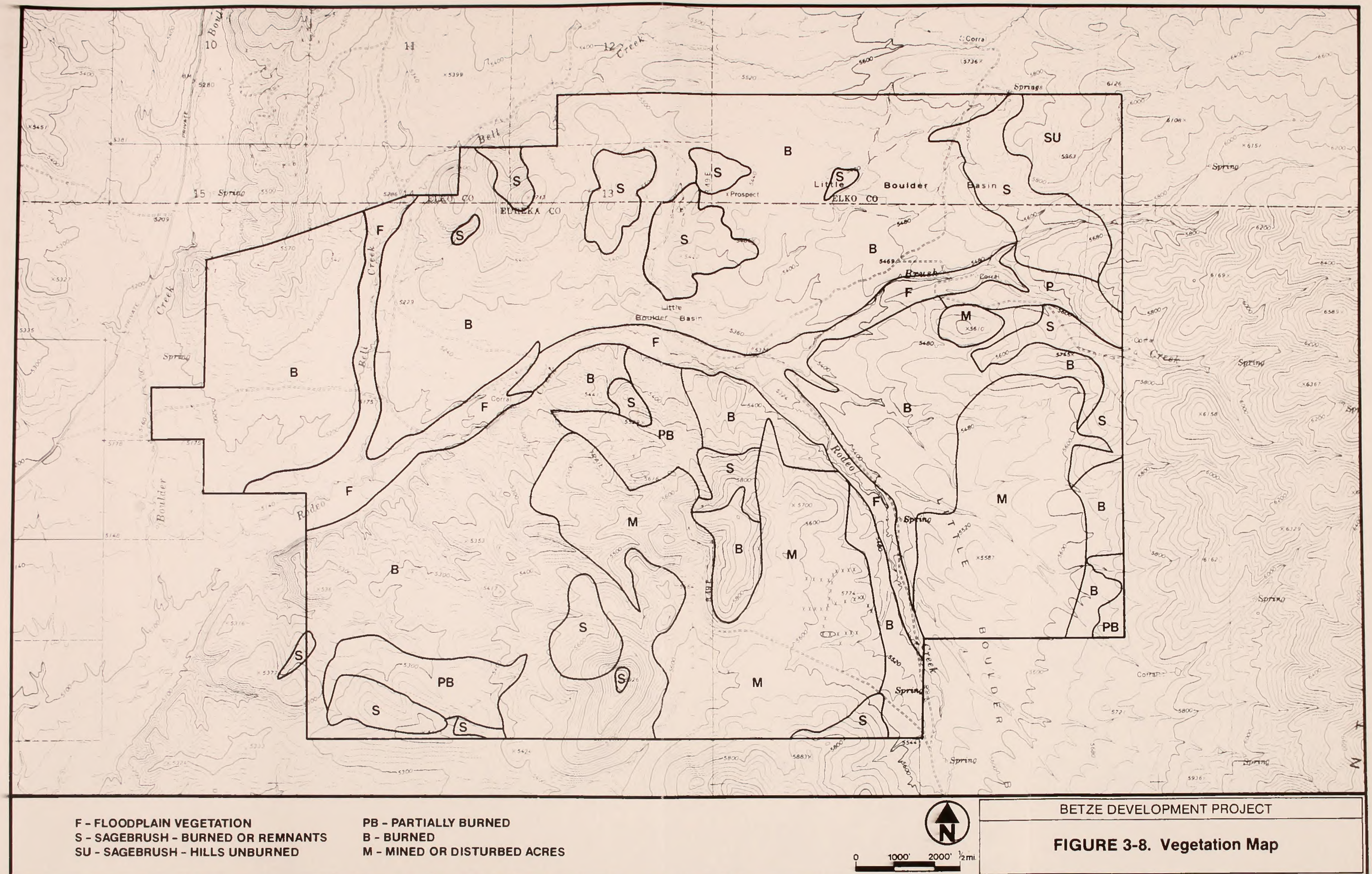

FIGURE 3-8. Vegetation Map

The Sagebrush-Burned community is dominated by basin big sagebrush which comprises 61 percent of the community. The understory is composed of annual and perennial species found in the other burned sites. Vegetative cover averages about 25 percent (JBR Consultants Group 1989).

Seeding efforts in burned areas have produced a Burned-Seeded community dominated by the seeded species, crested wheatgrass (Agropyron cristatum), which comprises about 73 percent of the community. This community is interspersed with the Burned-Unseeded areas, and vegetative cover averages approximately 26 percent, (JBR Consultants Group 1989).

In the Burned/Unseeded community, all indigenous plant cover was removed by fire. This plant community is commonly found on rocky or shallow sites. The community varies because it includes all the burned areas that either failed from seeding or were not reseeded. Regrowth depends upon the aspect, slope, and soils and represents an early successional stage in the transition from burn to climax. Therefore, it is not a true community. Current land use practices may be slowing or altering the transition. Vegetation cover in this community averages approximately 23.5 percent with 15.5 percent at the lower elevations. Cheatgrass and Sandberg bluegrass (Poa secunda), comprising 37 percent and 25 percent, respectively, are the dominant species in this community (JBR Consultants Group 1989).

There are also areas that were partially burned. As stated previously, regrowth is not a true vegetative community; it is an early successional stage between the burn and a climax community; and consists primarily of: cheatgrass, bluegrass, and basin big sagebrush. Often, small pockets of sagebrush community are surrounded by regrowth. The invasion by rubber rabbitbrush (Chrysothammus nauseosus) and an increase in cheatgrass have been the major changes in this area. Species found in the Sagebrush-Unburned and Burned/Unseeded areas can also be found in this type.

3.6.2 Floodplains

Floodplain locations appear to have changed and are continuing to change due to past and present land uses, especially heavy grazing by domestic livestock. In arid environments, domestic livestock concentrate in the small riparian plant communities and meadows resulting in overuse of these areas, compaction of soils, and a breaking down of stream banks by

The Sagebrush-Burned community is dominated by basin big sagebrush which comprises 81 percent of the community. The understory is composed of annual and perennial species found in the other burned sites. Vegetative cover averages about 15 percent (JBR Consultants Group 1989).

Seeding efforts in burned areas have produced a Burned-Seeded community dominated by the seeded species, crested wheatgrass (Agropyron cristatum), which comprises about 73 percent of the community. This community is interspersed with the Burned-Unseeded areas, and vegetative cover averages approximately 26 percent. (JBR Consultants Group 1989)

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There are also areas that were partially burned. As stated previously, regrowth is not a true vegetative community; it is an early successional stage between the burn and a climax community, and consists primarily of: cheatgrass, bluegrass, and basin big sagebrush. Often, small pockets of sagebrush community are surrounded by regrowth. The invasion by rubber rabbitbrush (Chrysothamnus nauseosus) and an increase in cheatgrass have been the major changes in this area. Species found in the Sagebrush-Unburned and Burned-Unseeded areas can also be found in this type.

3.4.2 Floodplains

Floodplain locations appear to have changed and are continuing to change due to past and present land uses, especially heavy grazing by domestic livestock. In arid environments, domestic livestock concentrate in the small riparian plant communities and meadows resulting in overuse of these areas, compaction of soils, and a breaking down of stream banks by

the hoofs of the grazing livestock. The accelerated erosion in these areas has led to headcutting and entrenchment of the streams, which have contributed to a major change in the vegetation community. Basin big sagebrush and rubber rabbitbrush, which are both very deep rooted, have replaced the shallower rooted grasses and forbs which once dominated the floodplains.

The floodplain community consists of 87 acres and is restricted to deep alluvial soils along the streams in Little Boulder Basin. Vegetative cover in this community averages 72 to 89 percent. Basin big sagebrush is the dominant species comprising 88 percent of the vegetation (JBR Consultants Group 1989).

3.6.3 Mined Lands

This category comprises 1,390 acres and includes all lands that have been, or are currently, disturbed by mining activities on the claim blocks. Plant communities have been completely removed or small remnants left scattered among the altered terrain. Invader species can be found on the less active sites. An interim reclamation program was initiated on several small sites.

3.7 Wildlife Resources

Wildlife studies were conducted in Little Boulder Basin from November 1987 to August 1988 as part of the baseline data collection program for Barrick's South Block (JBR Consultants Group 1989).

3.7.1 Terrestrial Biota

Three basic wildlife habitats have been described in Little Boulder Basin: the mountains and hills of the Tuscarora Range, the piedmonts, and the floodplains. Most of the native vegetation in Little Boulder Basin has been replaced by annuals and exotic grasses following range fires, grazing, and reseeding (see Section 3.6) (JBR Consultants Group 1989).

Typical game species which inhabit Little Boulder Basin include sage grouse (Centrocercus urophasianus), chukar (Alectoris chukar), Hungarian partridge (Perdix perdix), mourning dove (Zenaida macroura), mule deer (Odocoileus hemionus), and pronghorn antelope (Antilocapra americana). Although sage grouse historically inhabited much of the sagebrush lands in the area, wildfires and rehabilitation of the range with grasses has

the soils as the grazing livestock. The accelerated erosion in these areas has led to headcutting and entrenchment of the streams, which have contributed to a major change in the vegetation community. Basin big sagebrush and rabbitbrush, which are both very deep rooted, have replaced the shallower rooted grasses and forbs which once dominated the floodplains.

The floodplain community consists of 67 acres and is restricted to deep alluvial soils along the streams in Little Boulder Basin. Vegetative cover in this community averages 72 to 89 percent. Basin big sagebrush is the dominant species comprising 68 percent of the vegetation (JBR Consultants Group 1989).

3.6.3 Mined Lands

This category comprises 1,780 acres and includes all lands that have been, or are currently, disturbed by mining activities on the claim blocks. Plant communities have been completely removed or small remnants left scattered among the altered terrain. Invader species can be found on the less active sites. An interim reclamation program was initiated on several small sites.

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resulted in a much lower quality of habitat for this species. Sage grouse are now rarely observed south of Brush Creek and are not expected to occur along Rodeo Creek. Present grouse populations appear to be concentrated in the Bell Creek drainage (JBR Consultants Group 1989).

A major sage grouse lek is located on the terrace south of Bell Creek in Barrick's North Block. The lek extends the length of the open southwest-facing slope. Several small satellite leks have been noted in the area: one on the ridge west of the main lek and two across Bell Creek to the north. Field searches did not reveal any hen use close to the main lek. This may be due to the lack of large sagebrush stands. Sage grouse broods were discovered along the foothills of the Tuscarora Range, 1 to 2 miles east of the lek (JBR Consultants Group 1989).

Viable chukar populations occur in the hills flanking Little Boulder Basin, especially on the open ridges with rock outcrops and slopes of cheatgrass (JBR Consultants Group 1988b). Chukar will use some sagebrush cover, especially those areas previously burned which have developed a cheatgrass understory. While chukar use is primarily in the hills, they occasionally come to the valley streams, but quickly return to the high ridges for cover and food (JBR Consultants Group 1989).

A small number of Hungarian partridge inhabit this area throughout the year. Partridges are known to utilize lower Rodeo and Brush Creeks. Hungarian partridge habitat is centered around the floodplains and adjacent terraces (JBR Consultants Group 1989).

Mourning doves nest in Little Boulder Basin during the summer. Doves arrive in May and leave during late August or early September. These birds use all habitats and nest on the ground or in low shrubs. Burned, non-seeded areas seem to be preferred feeding sites for doves. Mourning dove use of the area outside of Little Boulder Basin is transitory and scattered in the spring and summer (JBR Consultants Group 1989).

Mule deer use the area primarily for fall and spring range when they move between their summer and winter ranges. The deer move south to Boulder Flats and the lower Boulder Valley for the winter. The open terrain and lack of escape and thermal cover in the Tuscarora Range and adjacent basins severely restricts winter use by deer when snow cover is present. BLM rates the range as being in fair condition and does not collect any AUM data for deer use in the area (BLM 1988a). The Nevada Department of Wildlife does not rate this range as critical or crucial deer

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winter range (BLM 1988a). During the summer, deer move to the higher elevations of the main Tuscarora Range. Few deer are found in Little Boulder Basin during the summer, due to the open terrain and lack of cover (JBR Consultants Group 1989).

Pronghorn antelope have recently expanded their range into the north Boulder Valley area due to the favorable water distribution and feeding areas in the valley (BLM 1988f). Antelope are known to winter in the Sheep Creek range and disperse east and north in the spring. Antelope have been observed near the Bootstrap Mine and on the terrace south of Bell Creek during the spring and summer (JBR Consultants Group 1989).

Ducks and shorebirds are commonly found along Boulder, Bell, and Rodeo Creeks and in the stock ponds associated with these streams. While many birds utilize these water bodies temporarily during migration, some species such as mallards (Anas platyrhynchos), gadwalls (Anas strepera), and cinnamon teal (Anas cyanoptera), nest in uplands adjacent to the stock ponds. There may be one or two nesting pairs at each pond. Some shorebirds such as killdeer (Charadrius vociferus) also nest adjacent to ponds and wet meadows. Coots (Fulica americana) are known to nest in the emergent vegetation around the stock pond on Rodeo Creek. Great blue herons (Ardea herodias) and black-crowned night herons (Nycticorax nycticorax) have been observed regularly using the streams and stock ponds for feeding, primarily along the Humboldt River (JBR Consultants Group 1989).

Several species of raptors have been observed in the project area. The American kestrel (Falco sparverius) is common in Little Boulder Basin. This small falcon nests in holes in the banks of the entrenched Brush and Rodeo creeks. Two eyries were located during recent surveys, and a third may exist along the streams. Kestrels prefer open country where they prey on insects and small mammals (JBR Consultants Group 1989).

Prairie falcons (Falco mexicanus) appear to be concentrated in Boulder Valley, although individuals may be seen elsewhere. One known eyrie is located on lower Boulder Creek (JBR Consultants Group 1989).

According to JBR Consultants Group (1989), the red-tailed hawk has been observed in Little Boulder Basin. A pair of red-tailed hawks (Buteo jamaicensis) has nested in the abandoned pit near the south boundary of the South Block at the Goldstrike Mine. This pair's territory extended across

winter range (BLM 1983a). During the summer, deer move to the higher elevations of the south Tuscarora Range. Few deer are found in Little Boulder Basin during the summer, due to the open terrain and lack of cover (JBR Consultants Group 1989).

Pronghorn antelope have recently expanded their range into the north Boulder Valley also due to the favorable water distribution and feeding areas in the valley (BLM 1983b). Antelope are known to winter in the Sheep Creek range and disperse east and north in the spring. Antelope have been observed near the Bootstrap Mine and on the terrace south of Bell Creek during the spring and summer (JBR Consultants Group 1989).

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the south boundary of the Goldstrike Mine and south into the hills toward the Bluestar-Genesis Mine.

Golden eagles (Aquila chrysaetos) are occasionally seen in Little Boulder Basin. During surveys conducted in 1988, most observations were of flights from one side of the basin to the other. One pair of golden eagles was repeatedly seen in the Brush Creek drainage of the Tuscarora Range, but no nest was observed (JBR Consultants Group 1989). Golden eagles have been observed perched on powerline poles in the western portion of Barrick's South Block (BLM 1988a).

Northern harriers (Circus cyaneus) have been occasionally observed coursing back and forth over the open terraces searching for small mammals or birds. Harriers occur in open shrub country and usually nest on the ground within the shrub cover. No paired or territorial birds were recorded during the raptor surveys (JBR Consultants Group 1989).

The only owl known to occur in Little Boulder Basin is the great-horned owl (Bubo virginianus). One individual was flushed from a roost along lower Rodeo Creek (JBR Consultants Group 1989).

Ravens (Corvus corax), which readily adapt to human activities, are common in the project area throughout the year. A nest with six young birds was found in the hills north of Rodeo Creek (JBR Consultants Group 1989).

Many species of passerines inhabit the ecosystems found in Little Boulder Basin. Since the burned terraces and other open terrain contain virtually no vegetative cover, only ground nesters like the horned lark (Eremophila alpestris) and western meadowlark (Sturnella neglecta) are able to exist there. The highest density and diversity of birds occurs in the floodplains due to the presence of wetlands and dense shrub cover. Although riparian vegetation generally supports a greater variety and density of birds than any other vegetation type, stream entrenchment has greatly diminished the riparian vegetation in Little Boulder Basin. The presence of vertical soil banks in the stream channel, however, has enabled many cavity-nesting species to occupy the floodplains (JBR Consultants Group 1989).

The open, arid terrain of Little Boulder Basin supports large and varied populations of small mammals and birds which make up the prey base of the area's mammalian predators and raptors. Numerous lagomorphs, rodents, and birds are able to find cover either in the short, sparse

the south boundary of the Carlstrike line and south into the hills towar the Bluewater-Natoma Sites.

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vegetation as is done by the black-tailed jack rabbit (Lepus californicus) or by burrowing into the soil like the mountain cottontail (Sylvilagus nuttallii). These animals successfully exploit the limited vegetation food sources and, in turn, provide food for the coyotes (Canis latrans), badgers (Taxidea taxus), gray fox (Urocyon cinereoargenteus), and kit fox (Vulpes macrotis). Raccoons (Procyon lotor) live along Boulder and Rodeo creeks and feed upon a number of prey items including insects, bird eggs, and fish (JBR Consultants Group 1989; Burt and Grossenheider 1976). Bobcats (Lynx rufus) dwell in the main Tuscarora Range and may occasionally enter the project area (JBR Consultants Group 1989).

Although amphibians and reptiles are not a prominent part of the area's ecosystem, due to the cool climate, several species have been observed in the project area. The desert horned lizard (Phrynosoma platyrhinos), the most abundant reptile in Little Boulder Basin, is common on the foothills and terraces. The sagebrush lizard (Sceloporus graciosus) has been recorded in unburned patches of sagebrush at lower elevations. Although neither species is very common in the project area, the western yellow-bellied racer (Coluber constrictor mormon) has been recorded only in the floodplain habitat, and the Great Basin gopher snake (Pituophis melanoleucus deserticola) has been found in the foothills and on the terraces. Reptiles in Little Boulder Basin are active from May to early September and are only a small part of the prey base of the area (JBR Consultants Group 1989).

3.7.2 Aquatic Biota

According to studies conducted in November 1987 and April 1988 (JBR Consultants Group 1989), habitat quality of Rodeo, Brush, and Boulder creeks in the project area is moderate to poor. In 1987, invertebrates were sampled at six stations established along the entire 5.6-mile Rodeo Creek. As typically occurs in headwater habitats with low flows, macroinvertebrate diversity was slightly reduced in the two stations closest to the headwaters. The middle three stations not only exhibited greater diversity and biomass of macroinvertebrates, but they also contained pollution-sensitive invertebrates such as mayflies (Cinygmula), stoneflies (Zapada and Capnidae), beetles (Deronectes), and Tipula flies. The station closest to the confluence with Boulder Creek exhibited the lowest biological populations and diversity due to increased sedimentation.

vegetation as is done by the black-tailed jack rabbit (Lepus californicus) or by burrowing into the soil like the mountain cottontail (Sylvilagus nuttallii). These animals successfully exploit the limited vegetation food resource and, in turn, provide food for the coyotes (Canis latrans), badgers (Taxidea taxus), gray fox (Urocyon cinereoargenteus), and kit fox (Vulpes macrotis). Raccoons (Procyon lotor) live along Boulder and Rodeo creeks and feed upon a number of prey items including insects, bird eggs, and fish (JBR Consultants Group 1989; Burt and Grossenheider 1976). Bobcats (Lynx rufus) dwell in the main Tuscarora Range and may occasionally enter the project area (JBR Consultants Group 1989).

Although amphibians and reptiles are not a prominent part of the area's ecosystem due to the cool climate, several species have been observed in the project area. The desert horned lizard (Phrynosoma platyrhinos), the most abundant reptile in Little Boulder Basin, is common on the foothills and terraces. The sagebrush lizard (Sceloporus graciosus) has been observed in unburned patches of sagebrush at lower elevations. Although neither species is very common in the project area, the western yellow-bellied racer (Coluber constrictor mormon) has been recorded only in the floodplain habitat, and the Great Basin gopher snake (Pituophis melanoleucus deserticola) has been found in the foothills and on the terraces. Reptiles in Little Boulder Basin are active from May to early September and are only a small part of the prey base of the area (JBR Consultants Group 1989).

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Studies conducted in 1988 showed that hardy, pollution-resistant species had replaced many of the pollution-sensitive invertebrates throughout the creek. According to data gathered in 1988, this appeared to be due to increased sedimentation and low stream flow (JBR Consultants Group 1989).

Brush Creek can be divided into three segments: the upper section with small perennial flows in the foothills of the Tuscarora Range, the intermittent mid-section, and the lower perennial section maintained by spring flows. The upper section of Brush Creek contained a relatively high number of organisms including caddisflies (Hesperophylax) and Helicopsyche (Trichoptera) which typically occur in clean-water habitats, as well as pollution-resistant flies (Diptera). Brush Creek had a much higher diversity of aquatic macroinvertebrates in the lower section than in the upper section. Several species typically found in lentic habitats, such as water boatmen (Corixidae) and predaceous diving beetles (Dytiscidae), as well as species associated with clean-water habitats, such as stoneflies (Isoperla) and caddisflies, occurred in the lower section of Brush Creek. Although the water quality in the lower section of Brush Creek is relatively high and there exists a wide variety of habitats, the gradient and substrate may not be ideal for certain macroinvertebrate fauna (JBR Consultants Group 1989).

Boulder Creek has been heavily disturbed below Rodeo Creek and contained a very low diversity of macroinvertebrates. Only very hardy macroinvertebrates occurred in this section of Boulder Creek due to extensive deposits of fine-grained sediments in the streambed (JBR Consultants Group 1989).

3.8 Threatened and Endangered Species

3.8.1 Plants

According to the Nevada Natural Heritage Program (Kolar 1990), there are no threatened or endangered plants known to occur in the project area. The nearest occurrence of rare plants is *Cryptantha interrupta* which occurs on rocky hillsides 5 miles south of Carlin, and *Astragalus pterocarpus* which occurs in the saltbush community around saline flats 2 miles south of Boulder Flats (BLM 1988f). The sand cholla (*Opuntia pulchella*) which occurs in the Sheep Creek Range/Boulder Creek area is protected by the "Cacti and Yucca Law" (Nevada Revised Statute 527.270). This law requires

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review of environmental documents prepared for projects that could significantly impact protected species and requires consultation with pertinent agencies regarding mitigation measures. The Nevada Division of Forestry is responsible for enforcement and permits.

3.8.2 Animals

According to the Nevada Natural Heritage Program (Kolar 1990), there are no threatened or endangered animal species known to occur in the project area. Peregrine falcons (Falco peregrinus) and an occasional bald eagle (Haliaeetus leucocephalus) may migrate through the area; however, the habitat is not suitable for year-round use (BLM 1988a).

There are two subspecies of Townsend's big-eared bat: Plecotus townsendii pallescenes and P. t. townsendii. Plecotus townsendii pallescenes occurs throughout Nevada but is not listed as a sensitive species; P. t. townsendii is listed as a federal category 2 species but does not occur in Nevada (Cross 1990; U.S. Fish and Wildlife Service 1989). Plecotus townsendii townsendii was historically found in California, Oregon, Washington, Idaho, and Canada (U.S. Fish and Wildlife Service 1989). There is currently no file in the U.S. Fish and Wildlife Service office in Reno or in the Nevada Department of Wildlife in Elko on either subspecies of Townsend's big-eared bat (Elpers 1990; Erickson 1990).

The Lahontan speckled dace (Rhinichthys osculus robustus) is listed as a state-sensitive species only because there is little known about it. This fish was found throughout most of Rodeo Creek, in the upper and lower sections of Brush Creek, and in Boulder Creek (JBR Consultants Group 1989). The species occurs throughout much of Nevada and often replaces trout as stream conditions deteriorate (Evans 1990).

3.9 Recreation/Wilderness

3.9.1 Recreation

The public lands within the BLM's Elko Resource Area (RA) provide diverse recreation opportunities ranging from snow skiing to whitewater rafting. The greatest demand results from reservoir fishing, sightseeing, upland game bird hunting, and mule deer hunting (BLM 1985).

The Betze Project area is located in terrain lacking unusual features or water-based recreational sites to attract people. The main recreational

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The Betze Project area is located in terrain lacking unusual features or water-based recreational areas to attract people. The main recreational

opportunities are dispersed types such as hunting, off-road vehicle (ORV) use, and rockhounding. Even these opportunities are relatively limited because many of the lands are now intensively utilized for mining activities; there is heavy mining-related truck use on the roads, and access to many areas is restricted by mining company safety closures and security gates on roads.

Recreational ORV use is dispersed throughout the RA. The project area is open to ORV use under the BLM's management decision to open the entire resource area except for special designated areas (BLM 1987a). The specific management prescription regarding ORV use designates 98 percent of the RA open to ORVs, and the remaining 2 percent, consisting of Special Recreation Management Areas (SRMAs) and portions of Wilderness Study Areas (WSAs), limited to designated roads and trails (BLM 1987a).

There are no SRMAs within or in close proximity to the project area (BLM 1987a). The closest proposed BLM SRMA is the 3,360-acre South Fork Canyon located approximately 30 miles southeast of the project area (BLM 1987a). The closest proposed non-federal recreation site is Rock Creek Reservoir (Lander County) located approximately 15 miles southwest of the project area (BLM 1987a). The remainder of the Elko RA, outside the WSAs and SRMAs, is managed for dispersed recreation activities.

The communities of Elko and Carlin provide more urbanized recreational facilities, including swimming pools, tennis courts, basketball courts, parks, playgrounds, softball fields, and little league fields.

3.9.2 Wilderness

The project area is located in terrain with hills and relatively small mountain ranges that have extensive backcountry road systems. This, plus the evidence of past and present mining activities, eliminated the general area around the Barrick project lands from consideration as a Wilderness Study Area (WSA) early in the review process.

The closest WSA is the Little Humboldt River WSA located approximately 27 miles northwest of the project area (BLM 1987a). This 42,213-acre unit is arranged along a 14-mile long diagonal axis running northwest to southeast and is about 9 miles wide. The WSA includes the upper drainage basin of the South Fork Little Humboldt River, situated between the middle slopes of the Snowstorm Mountains on the west, Castle

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Ridge on the east, Owyhee Bluffs on the south, and the Owyhee Desert on the north.

This WSA provides excellent diversity of primitive recreation opportunities including hiking, camping, stream fishing, hunting, nature study, photographic areas, rock climbing, and wildlife observation plus the potential for a system of horse trails. One of the significant opportunities within the WSA exists in viewing and photographing wild horses; portions of the Little Humboldt and Bullhead Wild Horse Herd Areas are located within the Little Humboldt River WSA (BLM 1987a).

The preliminary decision by the BLM is to recommend a portion (29,775 acres) of the Little Humboldt River WSA suitable for wilderness designation and 12,438 acres as non-suitable for wilderness designation (BLM 1987a). A final decision will be made by the U.S. Congress after 1991. All WSAs will continue to be managed under the BLM's Interim Management Policy and Guidelines for Lands Under Wilderness Review until completion of the wilderness review process (BLM 1987a).

3.10 Aesthetic Resources

3.10.1 Visual Resources

The visual resource investigation was conducted using procedures established in the BLM Manual, Section 8400, Visual Resource Management (VRM). Under the VRM system, the affected environment for visual resources is characterized using an inventory and evaluation process that addresses scenic quality, viewer sensitivity, and distance between viewers and a proposed modification to the landscape, the Betze Project in this case. The results of the three-step inventory process are used to determine visual resource management classes for lands in the project area. Each VRM class has specific objectives defining how the visual environment is to be managed on lands so designated. Table 3-11 illustrates the range of VRM classes and their associated management objectives.

The visual resource study area for the proposed Betze Project is defined as the viewshed of the project, or the area from which the project would be seen. This includes Little Boulder Basin and part of the Boulder Creek Valley between the Sheep Creek Range and the Tuscarora Mountains.

The study area is located in the Basin and Range physiographic province as defined by Fenneman (1931). The province is characterized by a

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TABLE 3-11

VISUAL RESOURCE MANAGEMENT CLASSES

Class I Objective:	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
Class II Objective:	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
Class III Objective:	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
Class IV Objective:	The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.
Rehabilitation Areas:	Areas in need of rehabilitation from a visual standpoint should be flagged during the inventory process. The level of rehabilitation will be determined through the resource management planning (RMP) process by assigning the VRM class approved for that particular area.

Source: BLM Manual Handbook 8410-1.

series of relatively low and generally undistinguished, north-south trending mountain ranges separated by broad alluvial valleys or basins.

Topography of the study area consists of low rolling hills at the foot of the Tuscarora Mountains cut by flat, gently sloping valleys 0.5 to 1.5 miles wide along Rodeo, Brush, and Boulder creeks. The Tuscarora Mountains stand above the project site by over 3,000 feet at a nearby 8,600-foot pinnacle, but the moderate slopes and rounded forms are generally similar to the lower foothills.

Vegetation in the study area is very homogeneous, consisting of low shrubs and grasses. Shrub species are limited to rabbitbrush and sages which exhibit generally uniform growth habit and coloration. Vegetation colors range from grey-green to medium olive with a muted buff yellow for a brief period when the rabbitbrush is in flower.

Major creeks in the area are considered perennial but they are barely noticeable from most of the study area. Natural colors in the study area are muted with very little variety. Soils are brown with subtle tints ranging from greyish brown to buff.

The dominating visual feature of the study area is the extensive network of mining activity that occupies much of a 10-mile segment of the Carlin Trend from the Dee Gold project to the Carlin Mine. The native topography has been transformed into a series of flat-topped, steep-sided, geometric benches woven together by a maze of haul roads and access roads. Several square miles extending southward from Newmont's Mill No. 4 are, for practical purposes, almost totally disturbed by existing mining activity. The disturbed area includes most of the AA block, the proposed Extended South waste rock disposal area, and the existing and proposed pit area. Vegetation has been removed from much of the area; rock and soil colors range from light grey to black with many hues of brown from buff and golden to near maroon.

A substantial majority of visitors to the study area are mine workers. The public has access to the study area via Boulder Valley Road or from Maggie Creek Road across the Tuscarora Mountains; however, traffic not related to local mines is very light. The project area is not visible from major travel routes or recreation use areas in the region. The project area is in foreground/middleground viewing distance for viewers on local roads. Based on the predominance of mine workers among potential viewers

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and the limited recreational opportunities in the area to attract other users, viewer sensitivity to visual resources is considered to be low.

The BLM's generalized VRM classification map designates most of the project area as Class IV with a strip of Class III along the eastern side at the foot of the Tuscarora Mountains (Figure 3-9). Site-specific application of the VRM system inventory procedures suggests a Class III designation for the lower foothills of the Tuscaroras is marginal, and the demarcation line between Class III and Class IV areas should be farther east (Figure 3-9). Management objectives for VRM Class III and Class IV areas are specified in Table 3-11.

3.10.2 Noise

A description of the environment potentially affected by noise emissions from the proposed project includes identification of noise-sensitive receptors and existing noise sources in the vicinity, characterization of terrain features that may affect noise transmission, and determination of existing noise levels.

The proposed Betze Project is located in an unpopulated, remote valley. There are no occupied, year-round residences or other sensitive receptors within several miles of the proposed project area. There is an old line shack, currently hosting two travel trailers, on Boulder Creek just off the southwest corner of the Clydesdales Block. Although this site is believed to be occupied only seasonally by TS Ranch workers, it will be used as a designated worst-case sensitive receptor for analytical purposes.

The principal sources of noise in the area are existing mining and milling operations by Barrick at the Goldstrike Project and by Newmont on adjacent properties. Wind and, to a lesser degree, insects and birds also contribute to existing ambient noise in the vicinity.

Terrain in the project area is extremely complex. As a result, there are probably locations near existing mining activity that are effectively shielded from mining noise. There may also be locations where noise is focused and intensified by terrain. No attempt was made to analyze terrain effects in detail because of the lack of noise-sensitive receptors in the area. The TS Ranch line shack site is shielded by terrain from current activity in the pit area and from Barrick's milling and leaching areas.

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The BLM's preexisting VRM classification map designates most of the project area as Class IV with a strip of Class III along the eastern side at the foot of the Tuscarora Mountains (Figure 3-8). Site-specific application of the VRM system inventory procedures suggests a Class III designation for the lower foothills of the Tuscaroras is marginal, and the demarcation line between Class III and Class IV areas should be further east (Figure 3-8). Management objectives for VRM Class III and Class IV areas are specified in Table 3-11.

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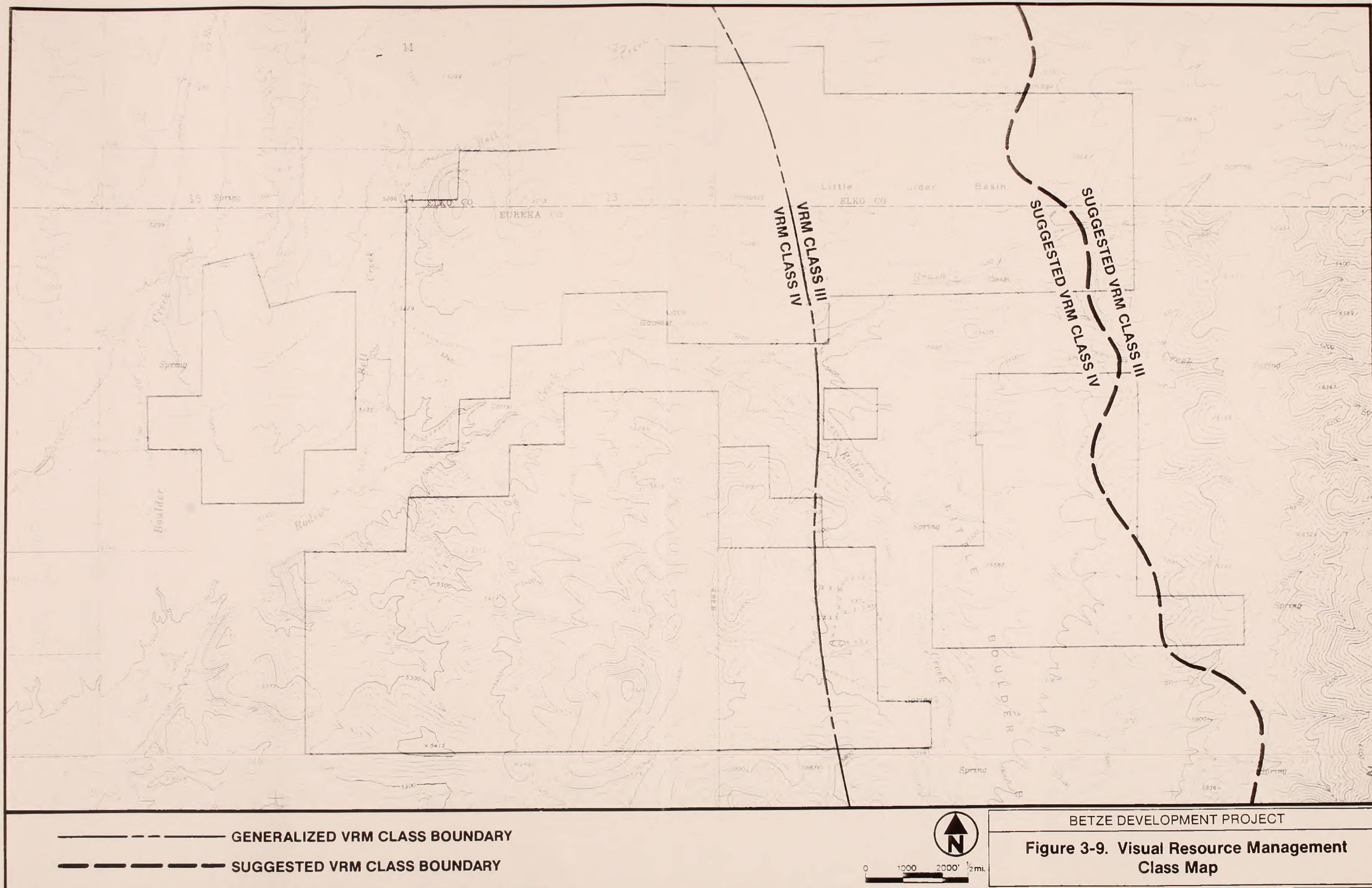

BETZE DEVELOPMENT PROJECT

Figure 3-9. Visual Resource Management Class Map

Monitoring of existing noise levels was not deemed necessary because of the remote location of the project, the existing mining operation, and the fact that there are no sensitive receptors in the area. It is estimated, based on EPA literature, site visits, and previous experience with mining projects in remote areas, that existing noise levels range from 40 to 65 decibels, A-weighted (dBA) in most of the project area, except in close proximity to high activity areas. The lower end of the range represents noise levels one would experience in a small rural community. Quieter parts of the study area would be at or below this level much of the time. The upper end of the range represents areas where the background mechanical "hum" of mining and milling activity would be commonly perceived but not at close enough range to interfere with conversation.

3.11 Cultural Resources

3.11.1 Cultural Resources Investigations

Information concerning cultural resources in the Betze Project area is found in cultural resource inventories and other studies conducted on lands under management of the BLM Elko District Office. Most of these inventories apply directly to the Betze Project area, although information from inventories in adjacent areas and data from excavations and inventories in the region are also relevant. Most inventories pertaining to the Betze Project area were conducted according to BLM standards in effect prior to 1989 (i.e., USDI 1985a), although that by Schroedl (1990) was conducted under newer standards (USDI 1989). Overviews of the paleoenvironment, prehistory, ethnohistory, and history are found in regional documents (James 1981; Rusco 1982a); as more project-specific summaries are found in cultural resource inventories and other reports discussed below.

Six reports of cultural investigations pertaining to the Betze Project area have been filed with the BLM Elko District Office. Three of these were limited to surface examination (Hicks 1989; Coulam 1988; Schroedl 1986); however, Schroedl's results were incorporated entirely in a subsequent report by Russell et al. (1986) discussing additional surface inventories as well as limited testing. Tipps and Coulam (1988) describe results of an excavation at one site and testing at another. Most

recently, Schroedl (1990) completed a surface inventory as well as limited subsurface probing.

3.11.2 Cultural Resources Identified in the Project Area

Based on inventory results, cultural resources within the Betze Project area include 262 archaeological sites (all but one prehistoric). The total includes 112 isolates, 67 small sites (i.e., 20 artifacts or less) and 83 large sites (Table 3-12). Appendix C lists the large and small sites but not isolates. None of the isolates have been recommended as eligible for the National Register of Historic Places (NRHP); the BLM and the Nevada State Historic Preservation Officer (SHPO) agree that isolates are not considered NRHP-eligible.

The BLM, in consultation with the SHPO, has concluded that one site, CRNV-12-5682, is eligible for the NRHP. Additional information is needed about numerous other large and small sites to complete the evaluation and make a conclusive determination about NRHP eligibility.

Among the earliest inventory reports, none is specific in identifying the criteria under which the archaeological sites were recommended as NRHP eligible. However, from the site descriptions, cultural resources overviews, and the nature of recommendations, it is apparent that the only eligibility criterion considered in these reports was the potential to yield important information about the past. Schroedl (1990) is specific in identifying this criterion as the basis for NRHP eligibility and further justifies that conclusion with regard to specific and appropriate research domains. In their evaluation of CRNV-12-5682, Tipps and Coulam (1988) specify the site's NRHP eligibility using this criterion. The site descriptions and overviews indicate that other NRHP eligibility criteria may not be applicable to any of the sites in the Betze Project area (Burke 1988).

3.11.2.1 Inventory Results. Schroedl (1986) examined an area corresponding to the leach pad, mill, and shop area in the AA Block. Six large sites and 17 small sites or isolates were recorded. Russell et al. (1986) continued the inventory in an area corresponding to the AA Block tailings dam. Russell et al. (1986) (also discussed in Barrick 1988a) examined an area along the south edge of the North Block, including the location of the sulfide ore stockpile and the southern edge of the

recently, Schroedl (1990) completed a surface inventory as well as limited subsurface probing.

3.11.2 Cultural Resources Identified in the Project Area

Based on inventory results, cultural resources within the Betze Project area include 202 archaeological sites (all but one prehistoric). The total includes 116 isolates, 67 small sites (i.e., 20 artifacts or less) and 19 large sites (Table 3-12). Appendix C lists the large and small sites but not isolates. None of the isolates have been recommended as eligible for the National Register of Historic Places (NRHP); the BLM and the Nevada State Historic Preservation Officer (SHPO) agree that isolates are not considered NRHP-eligible.

The BLM, in consultation with the SHPO, has concluded that one site, CrNV-12-5632, is eligible for the NRHP. Additional information is needed about numerous other large and small sites to complete the evaluation and make a conclusive determination about NRHP eligibility.

Among the earliest inventory reports, none is specific in identifying the criteria under which the archaeological sites were recommended as NRHP eligible. However, from the site descriptions, cultural resources overviews, and the nature of recommendations, it is apparent that the only eligibility criterion considered in these reports was the potential to yield important information about the past. Schroedl (1990) is specific in identifying this criterion as the basis for NRHP eligibility and further qualifies that conclusion with regard to specific and appropriate research domains. In their evaluation of CrNV-12-5632, Tipps and Coulam (1988) specify the site's NRHP eligibility using this criterion. The site descriptions and overviews indicate that other NRHP eligibility criteria may not be applicable to any of the sites in the Betze Project area (Burke 1988).

3.11.2.1 Inventory Results. Schroedl (1986) examined an area corresponding to the leach pad, mill, and shop area in the AA Block. Six large sites and 17 small sites or isolates were recorded. Russell et al. (1985) continued the inventory in an area corresponding to the AA Block tailings dam. Russell et al. (1985) (also discussed in Bartick 1985a) examined an area along the south edge of the North Block, including the location of the sulfide ore stockpile and the southern edge of the

TABLE 3-12

SUMMARY OF CULTURAL RESOURCES INVENTORY

RESULTS IN THE BETZE PROJECT AREA

Aurthor/ BLM Report No.	Acres	Total Sites	Large Sites	Small Sites & Isolates	Small Sites	Isolates
Russell et al. 1986[1]/1-1042(P)	1,032.5	59	15	44	28	16
Hicks 1989/ 1-1244(P)	3,698.0	186	60	126	34	92
Coulam 1988/ 1-1160(P)	128.7	2	2	0	0	0
Schroedl 1990/ 1-1323(P)	320.0	15	6	9	5	4
TOTAL	5,179.2	262	83	179	67	112

[1] Figures for this table include the AA Block area and other portions of the Betze Project Area.

proposed heap leach pad. Their inventory resulted in recordation of an additional 27 small sites or isolates as well as another 9 large prehistoric sites. None of the small sites or isolates were recommended eligible for the NRHP. Four sites (CRNV-12-5585, CRNV-12-5588, CRNV-12-5589, and CRNV-12-5682) were recommended for NRHP evaluation. Subsequently, the BLM and State Historic Preservation Office (SHPO) have agreed that 42 sites are not NRHP eligible while CRNV-12-5682 is eligible. The AA Block includes no sites eligible for the NRHP.

Hicks (1989) reports results of Class III inventories covering 3,698 acres in five discontiguous parcels. These include the Clydesdales Block, western portions of the Extended South waste rock disposal area in the South Block, the balance of the North Block not covered by Russell et al. (1986), and a small parcel labeled Buzz Block located northeast of the South Block claim area. Hicks recorded 92 isolated artifacts, 34 small prehistoric sites, 59 large prehistoric sites, and one large historic site. No small sites or isolates were recommended eligible for the NRHP. Hicks recommended 37 sites as eligible for the NRHP. However, the BLM Elko District Office has not formulated final opinions concerning the NRHP eligibility of any of the large or small sites, nor has consultation occurred between the BLM and SHPO on eligibility of sites recorded by Hicks. The BLM considers additional information necessary to complete the evaluation of 94 sites. The BLM has already identified 15 sites as requiring further work, a recommendation with which the SHPO agrees.

Coulam (1988) inventoried 129 acres in an area encompassing the sulfide ore stockpile situated on the southeast margin of the AA Block. Two large prehistoric sites were recorded. The BLM and SHPO have agreed that neither site is eligible for the NRHP.

Schroedl (1990) examined 320 acres of private land comprising an interior portion of the Extended South waste rock disposal area, to the east of the parcel examined by Hicks, and recorded six large sites, five small sites, and four isolates. One large site (CRNV-12-8185) has been recommended as NRHP-eligible. The BLM and SHPO had not completed consultation regarding the inventory or NRHP recommendations as of July 1990.

In 1988, the BLM examined aerial photographs of the South Block to determine which areas required investigation for cultural resources based on prior disturbance. In July 1988, the BLM advised Barrick that disturbed

proposed heap leach pad. Their inventory resulted in recordation of an additional 21 small sites or isolates as well as another 9 large prehistoric sites. None of the small sites or isolates were recommended eligible for the NRHP. Four sites (CrNV-12-5505, CrNV-12-5508, CrNV-12-5509, and CrNV-12-5567) were recommended for NRHP evaluation. Subsequently, the BLM and State Historic Preservation Office (SHPO) have agreed that 48 sites are not NRHP eligible while CrNV-12-5502 is eligible. The AA Block includes 47 sites eligible for the NRHP.

Bloss (1992) reports results of Class III inventories covering 2,900 acres in five noncontiguous parcels. These include the Clydesdale Block, western portions of the Extended South waste rock disposal area in the South Block, the balance of the North Block not covered by Russell et al. (1989), and a small parcel labeled Burn Block located northeast of the South Block Class area. Bloss recorded 32 isolated artifacts, 34 small prehistoric sites, 59 large prehistoric sites, and one large historic site. No small sites or isolates were recommended eligible for the NRHP. Bloss recommended 17 sites as eligible for the NRHP. However, the BLM Elko District Office has not formulated final opinions concerning the NRHP eligibility of any of the large or small sites, nor has consultation occurred between the BLM and SHPO on eligibility of sites recorded by Bloss. The BLM considers additional information necessary to complete the evaluation of 34 sites. The BLM has already identified 15 sites as requiring further work, a recommendation with which the SHPO agrees.

Quinn (1989) inventoried 129 acres in an area encompassing the southern-most stockpile situated on the southeast margin of the AA Block. Two large prehistoric sites were recorded. The BLM and SHPO have agreed that neither site is eligible for the NRHP.

Arnold (1990) examined 320 acres of private land comprising an interior portion of the Extended South waste rock disposal area, to the east of the parcel examined by Bloss, and recorded six large sites, five small sites, and four isolates. One large site (CrNV-12-8155) has been recommended as NRHP-eligible. The BLM and SHPO had not completed consultation regarding the inventory or NRHP recommendations as of July 1992.

In 1988, the BLM examined aerial photographs of the South Block to determine which areas required investigation for cultural resources based on prior disturbance. In July 1992, the BLM advised Barrick that disturbed

areas in the South Block would not require examination for cultural resources (Jaynes 1990).

3.11.2.2 Testing and Evaluation Results. Four large prehistoric sites have undergone formal testing of subsurface deposits to determine if they were eligible for the NRHP. Based on subsurface examination (Russell et al. 1986), sites CRNV-12-5585 and CRNV-12-5589 were not recommended as eligible for the NRHP. The BLM and SHPO have concurred that these sites are not NRHP-eligible. Tipps and Coulam (1988) reported results of testing and evaluation at CRNV-12-5682 (26Eu1320) and recommended the site for NRHP eligibility; the BLM and SHPO have concurred on the eligibility of the site for the NRHP. One prehistoric site (CRNV-12-5588/26Eu1319) in the AA Block was recorded by Schroedl (1990) and recommended as NRHP-eligible. Subsequently the site was the focus of intensive surface collection, extensive excavation and mechanical stripping (Tipps and Coulam 1988). No further work has been recommended for this site, and the BLM and SHPO agree the site cannot be considered NRHP-eligible.

3.11.3 The Potential for an NRHP District

All NRHP evaluations have been made on an individual basis. None of the previous inventory reports suggested that a grouping of properties, related by virtue of unification through past events or processes, be considered as an NRHP district. Although the district terminology is never used, Hicks (1989) seems to allude to the potential for an archaeological district which includes small and large sites lacking NRHP eligibility by themselves, but which might contain significant information about the project area and larger region if studied intensively.

Potential bases for district identification can include cultural affiliation, period of use, site type, or a research problem which entails intersite relationships, (USDI 1982:5). The National Park Service has recently refined district terminology and concepts (USDI n.d.a:7-8): "A district possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development" and derives importance"... from being a unified entity, even though it is often composed of a wide variety of features..." Significant districts must qualify under one or more NRHP criteria and usually satisfy that portion of the criterion

Areas in the South Block would not require examination for cultural resources (Haynes 1991).

3.11.2.2 Testing and Evaluation Results. Four large prehistoric sites have undergone formal testing of subsurface deposits to determine if they were eligible for the NRHP. Based on subsurface examination (Russell et al. 1988), sites CrNV-12-5585 and CrNV-12-5587 were not recommended as eligible for the NRHP. The BLM and SHPO have concurred that these sites are not NRHP-eligible. Tipps and Coulam (1988) reported results of testing and evaluation at CrNV-12-5662 (26Mn1320) and recommended the site for NRHP eligibility; the BLM and SHPO have concurred on the eligibility of the site for the NRHP. One prehistoric site (CrNV-12-5588/26Mn1319) in the M6 Block was recorded by Zeier (1990) and recommended as NRHP-eligible. Subsequently the site was the focus of intensive surface collection, extensive excavation and mechanical stripping (Tipps and Coulam 1990). No further work has been recommended for this site, and the BLM and SHPO agree the site cannot be considered NRHP-eligible.

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referring to a "...distinguishable entity whose components may lack individual distinction..." On the other hand, such components must retain their integrity.

A general historic context has been presented which could justify district designation: 1) prehistoric archaeological sites in the Betze Project area are in a little studied area and are of a type (i.e., open) which has often proven intractable in some previous archaeological analyses, although evidence for relatively good integrity of the surface deposits (i.e., spatial patterning) has been observed in the Betze Project area; 2) they may contribute significant information to a regional interpretation of the past (generally speaking the Archaic Period and the Late Prehistoric Period); 3) the scope of significant contributions to regional research questions could include, but is not necessarily limited to, lithic technology (highly specific as well as regional patterns of tool procurement, manufacture, and use), intra- and inter-site functional differences and spatial patterning, regional exchange systems subsistence, chronological refinement, and, ultimately, analysis of regional long-term patterns of cultural adaptation and change.

Based on present information, a district designation may be the appropriate mechanism to recognize the research potential of prehistoric archaeological sites in the Betze Project area (Burke 1988). While only one site has been evaluated as NRHP-eligible to date, several large sites have been recommended eligible, and other sites are currently being evaluated. Some small sites may qualify as part of such a district. Within any district, it would be necessary to define and justify the inclusion of "contributing" properties (i.e., those that add to the archaeological value of the district) as opposed to "non-contributing" properties (USDI 1985b). The BLM is currently evaluating the appropriateness of a district designation.

3.11.4 Native American Concerns

Intangible cultural values have emerged as a form of significance criterion (USDI n.d.b). For example, Indian tribes may have interests in cultural properties, including those which are not located on Indian lands, and those interests may constitute the basis for concluding that a cultural resource is NRHP eligible. In the case of the Betze Project area, the BLM has provided the Western Shoshone Tribe with information about the project

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but has received no response; it appears there are no pertinent Native American concerns (Jaynes 1990).

3.11.5 Status of Cultural Resources Investigations

All previous cultural resources reports have been found satisfactory and accepted by the BLM. As noted elsewhere, recommendations within one report (Hicks 1989) concerning NRHP eligibility for large and small sites are in abeyance pending accumulation of additional information required by the BLM. Further, the recommendations by Schroedl (1990) are pending consultation between the BLM and SHPO.

Certain areas within the claim blocks have not yet been inventoried; these include approximately 56 acres in three strips along the western edge of the Clydesdales Block (an alternative), approximately 9 acres on the northern edge of the North Block, and an area of approximately 13 acres in the AA Block, north of the sulfide ore stockpile area. A total area of approximately 894 acres outside claim blocks but within alternatives has not been inventoried for cultural resources.

3.12 Land Use

3.12.1 Land Status/Ownership

The Elko RA contains approximately 5,967,854 acres of which approximately 3,134,019 acres are under administration by the BLM (BLM 1985). The Elko RA encompasses portions of three counties; Elko (approximately 23 percent of the county), Eureka (approximately 19 percent of the county), and Lander (approximately 4 percent of the county) (BLM 1985). The public land pattern is generally consolidated, with the exception of a 40-mile wide band of checkerboard land consisting of alternating federal and private sections. This pattern was created when the Act of July 1, 1862 granted alternating sections of land to the Union Pacific and Central Pacific Railroads as incentive for construction of the transcontinental railroad. About two-thirds of this area remains in a checkerboard pattern (BLM 1985).

The land pattern in the vicinity of the Betze Project area is generally consolidated into blocks of public and private lands. The project area is located just north of the large checkerboard area of public and private land ownership.

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Certain areas within the claim blocks have not yet been inventoried. These include approximately 56 acres in three strips along the western edge of the Clydesdales Block (no alternative), approximately 9 acres on the northern edge of the north block, and an area of approximately 13 acres in the AA Block, south of the sulfide ore stockpile area. A total area of approximately 894 acres outside claim blocks but within alternatives has not been inventoried for cultural resources.

3.12 Land Use

3.12.1 Land Status/Ownership

The Elko RA contains approximately 3,967,034 acres of which approximately 3,116,019 acres are under administration by the BLM (BLM 1985). The Elko RA encompasses portions of three counties; Elko (approximately 81 percent of the county), Eureka (approximately 19 percent of the county), and Lander (approximately 4 percent of the county) (BLM 1985). The public land pattern is generally consolidated, with the exception of a 40-mile wide band of checkerboard land consisting of alternating federal and private sections. This pattern was created when the Act of July 1, 1862 granted alternating sections of land to the Union Pacific and Central Pacific Railroads as incentive for construction of the transcontinental railroad. About two-thirds of this area remains in a checkerboard pattern (BLM 1985).

The land pattern in the vicinity of the Betze Project area is generally consolidated into blocks of public and private lands. The project area is located just north of the large checkerboard area of public and private land ownership.

The Barrick Goldstrike property is controlled by Barrick Goldstrike Mines Inc., a subsidiary of American Barrick Resources Corporation. The property, located in Eureka and Elko counties, is divided into several non-contiguous groups of claims on public lands administered by the BLM and on some fee lands owned by Barrick.

3.12.2 Land Use

Land use in the project vicinity reflects typical land use patterns throughout the Elko RA and is primarily dominated by mining, grazing, wildlife habitat, dispersed recreation, and open space. The closest permanent residences are a number of ranch houses in lower Boulder Valley approximately 20 miles from the project area. The T S Ranch Joint Venture irrigation storage reservoir is being constructed approximately 1.5 miles southwest of the Betze Project area.

3.12.3 Land Use Plans

Given the large percentage of federal land in Eureka and Elko counties, federal management programs, particularly those administered by the BLM, will continue to have heavy influence on land use in the area. In addition, since the Betze Project area consists of unpatented mining claims on lands administered by the BLM, the BLM's land use plans, policies, and regulations have primary jurisdiction over land use activities on these parcels. The BLM has developed the current Elko Resource Management Plan (RMP) to guide long-term management of their lands. The development of the Elko RMP was the result of a long planning process which included preparation of three separate public documents: the Elko Resource Area Draft Resource Management Plan and Environmental Impact Statement (1985); the Elko Resource Area Final Proposed Resource Management Plan and Environmental Impact Statement (1986); and the Elko Resource Management Plan Record of Decision (1987a).

The following is a summary of the planning issues and management decisions contained in the RMP Record of Decision as they relate to the proposed project.

Land Tenure Adjustments and Corridors. The Betze Project area is located in an area designated for retention by the BLM. It is located just northeast of a large area identified for "transfer primarily by exchange".

The Bazza, Goldstrike property is controlled by Barrick Goldstrike Mines Inc., a subsidiary of American Barrick Resources Corporation. The property, located in Eureka and Elko counties, is divided into several noncontiguous groups of claims on public lands administered by the BLM and on some fee lands owned by Barrick.

3.12.2 Land Use

Land use in the project vicinity reflects typical land use patterns throughout the Elko RA and is primarily dominated by mining, grazing, wildlife habitat, dispersed recreation, and open space. The closest permanent residences are a number of ranch houses in lower Boulder Valley approximately 10 miles from the project area. The T S Ranch Joint Venture irrigation storage reservoir is being constructed approximately 1.5 miles southwest of the Betze project area.

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Land Tenure Adjustments and Corridors. The Betze Project area is located in an area designated for retention by the BLM. It is located just northeast of a large area identified for "transfer primarily by exchange".

There are no designated corridors or planning corridors traversing the project area.

Access. There are no roads identified as needing access acquisition considerations traversing the project area. The mine access road is a public road under the jurisdiction of Eureka County.

Recreation. Please refer to Section 3.9.1 of this EIS for a discussion of recreation.

Wilderness. Please refer to Section 3.9.2 of this EIS for a discussion of wilderness issues.

Wildlife. The project area is located in an area designated for "other deer winter range". Please refer to Section 3.7 of this EIS for a discussion of wildlife resources.

Woodland Products. There are no designated woodland product harvest areas in the vicinity of the project area. The closest fuel and posts harvest area is approximately 19 miles southeast of the project area. The closest Christmas tree harvest area is approximately 30 miles southeast of the project area.

Minerals. The objective of minerals management in the Elko RA is to maintain the public lands for exploration, development, and production of mineral resources while mitigating conflicts with wildlife, wild horses, recreation, and wilderness resources. The short- and long-term management actions include designating the RA open to mineral entry for locatable minerals, except for the District's 11-acre administrative site. The project area is located in an area designated as open to oil and gas and geothermal leasing, subject to standard leasing stipulations.

3.12.4 Livestock Grazing

A Rangeland Program Summary (BLM 1987b) was issued after completion of the Elko RMP to inform livestock permittees and the interested public about implementation of the rangeland management program. It identifies allotment-specific objectives for livestock, wildlife, and wild horses. It

outlines allotment-specific monitoring studies needed to evaluate the attainment of objectives and the range improvements proposed to implement the RMP.

The Barrick Project area is located within the extreme northern edge of the T Lazy S Grazing Allotment (BLM 1987a). There are 72,928 acres of public land within this allotment (BLM 1985). There is currently one licensed operator, the TS Joint Venture, utilizing the allotment (BLM 1987b). Total grazing preference within the allotment is 18,486 animal-unit-months (AUMs) for livestock (3.9 acres per AUM). Current active grazing preference and average licensed use is 15,250 AUMs for livestock and 396 AUMs for deer with an apparent downward trend (BLM 1985). The allotment is grazed from mid-March to the end of December (BLM 1985).

The T Lazy S allotment is categorized as an "Improve" allotment under the BLM's selective range management policy (BLM 1987b). This identifies the allotment as a high priority for improvement of rangeland production and condition based on consultation between the livestock operator and the BLM, with input from the Nevada Department of Wildlife (NDOW) and interested public.

The long-term management objective for the T Lazy S allotment is to provide forage to sustain 13,081 AUMs for livestock grazing and 793 AUMs for a reasonable number of mule deer (BLM 1987b).

3.12.5 Wild Horses

There are four Wild Horse Herd Areas (WHHAs) administered by the BLM Elko District (BLM 1987a). The closest BLM-designated WHHA is the Rock Creek WHHA located approximately 20 miles northwest of the project area (BLM 1987a).

3.13 Social and Economic Values

This section describes existing and projected socioeconomic conditions in the project area, including: population, employment, economy, income, housing, public services, and facilities and fiscal conditions. Numerous studies in Elko and Eureka counties have been completed in the past several years due to the gold-mining boom in the Carlin Trend district. The project area is defined as Elko and Eureka counties in north-central Nevada, including the towns of Elko and Carlin. It is anticipated that most construction and operation workers would reside in the Elko and Carlin

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area. It is not expected that Eureka County would experience impacts associated with the project construction or operations population. The primary impacts in Eureka County would relate to growth in the county property tax and net proceeds revenues.

3.13.1 Population and Demography

In the past decade, the State of Nevada has experienced significant population growth. There was a net gain of 376,270 people from 1980 to 1990, which represented a growth rate of 47 percent (Nevada Department of Taxation 1990). Most of this growth has been due to a net migration of new residents into the state for gambling-related service sector jobs, mining, and construction activities.

Elko County has grown at a faster rate than the state. During the same period, the county experienced a 108 percent increase in population due primarily to renewed exploration and mining activities along the Carlin Trend. The population grew from 17,573 in 1980 to an estimated 35,560 in 1990 (Nevada State Governor's Office/UNR-Bureau of Business Research 1990).

Population growth has occurred mainly in the incorporated areas of Elko and Carlin. The population of Carlin has grown from an estimated 1,300 in 1988 to 2,750 in 1989 (Nevada Department of Taxation 1990). The City of Elko's population increased from 8,758 in 1980 to an estimated 16,700 in 1989 (Nevada Department of Taxation 1990). The Northeast Nevada Development Authority (NENDA 1989) estimated the City of Elko population to be 17,500 in 1988. The immediate market area (30-mile radius) was estimated at 27,000 which would include the Spring Creek residential development, Carlin, and unincorporated Elko County. These estimates are considered to be more accurate than the Department of Taxation estimates. Both sets of numbers however, reflect the dramatic growth occurring throughout the area. Table 3-13 presents population data for the state, Elko County, the City of Elko, Eureka County, and Carlin from 1985 through 1990.

Other population estimates have been derived for the City of Elko. Chilton Engineering (1989) completed a wastewater treatment facility study which estimated current population in the City of Elko. The Chilton Engineering estimate was based on non-mining growth of 5 percent. Mining growth was based on information obtained from seven of the largest gold mines in or adjacent to Elko County. The population in the city of Elko

TABLE 3-13

STUDY AREA POPULATION
1985 THROUGH 1990

	1985	1986	1987	1988	1989	Projected 1990	Percent Increase	Average Annual Increase
Elko County	22,850	23,920	25,000	27,980 32,000[1]	33,270	36,560	60.0	9.9
City of Elko	10,800	10,980	13,310	14,620 16,393[2] 17,500[1]	18,156[2]	19,397[2]	79.6	12.4
Carlin	1,390	1,410	1,720	1,990	2,750	NA	97.8[3]	18.6
Eureka County	1,450	1,530	1,950	2,010	2,280	2,310	59.3	9.8
State of Nevada	967,820	1,008,030	1,053,230	1,095,880	1,198,450	1,280,380	32.3	5.8

Source: Nevada Department of Taxation, State Demographer.

[1]City of Elko Profile, 1988/1989. Northeast Nevada Development Authority (NENDA).

[2]Wastewater Facilities Planning Treatment Plant Expansion 11/7/88. Kennedy/Jinks/Chilton (Chilton Engineering).

[3]1985 through 1989.

was estimated at 16,393 for 1988, 12 percent (1,773) higher than the Nevada Department of Taxation estimate.

Projected population for Elko County, the City of Elko, and Carlin are shown on Table 3-13. Projected population estimates are based on the Nevada Employment Security Department (1990) employment projections and historical population to employment ratios.

3.13.2 Economy and Employment

The economy in Elko County has historically depended largely on the service industry, mining, and agriculture. The service industry in Elko County has experienced rapid growth due to increased gaming, particularly in Wendover and Jackpot.

Although agriculture does not employ a large share of the labor force, it remains a steady base of employment in the county. Livestock comprises the largest share of agriculture products sold in the county. More recently the mining and construction industries have become the major contributors to the economy of Elko County. Strong growth in employment has occurred since 1985 in most sectors of the economy due to an increase in gold exploration and production throughout the Carlin Trend area. The estimated number of jobs has increased more than 22 percent between 1986 and 1989, primarily in the mining and construction sectors (BLM 1989). Tables 3-14 and 3-15 show comparative monthly employment figures by sector for Elko and Eureka Counties for June 1987 through June 1989. Employment by sector is reported by place of work; therefore, employment in Elko County does not reflect the number of miners living in Elko County and working in Eureka County.

As shown in Table 3-14, growth occurred in all sectors, particularly in construction, trade, and mining. Table 3-15 shows the largest employment growth in the mining and construction sectors.

Unemployment throughout the State of Nevada has been steadily decreasing over the past years. The unadjusted unemployment rate for February 1989 was 5.8 percent which was comparable to the previous year. This is due primarily to the continued economic growth in the gaming, construction and mining sectors. Many new jobs are being filled by inmigrants.

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Projected populations for Elko County, the City of Elko, and Carlin are shown on Table 3-13. Projected population estimates are based on the Nevada Employment Security Department (1990) employment projections and historical population to employment ratios.

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TABLE 3-14

ELKO COUNTY

INDUSTRIAL EMPLOYMENT 3-YEAR/MONTHLY COMPARISON

	June 1987	June 1988	June 1989	Average Annual Increase	Percent Change
Total Industries	11,470	13,450	14,880	13.9	29.7
Mining	950	1,080	1,340	18.8	41.1
Construction	830	1,620	1,310	25.6	57.8
Manufacturing	130	130	180	17.7	38.5
TCPU[1]	640	710	740	7.5	15.6
Trade	2,020	2,360	2,990	21.7	48.0
Fire[2]	250	310	310	11.4	24.0
Service	4,810	5,320	5,930	11.0	23.3
Government	1,840	1,920	2,090	6.6	13.6

Source: Nevada Employment Security Department (employment by place of work).

[1] Transportation, communication, public utilities.

[2] Finance, insurance, real estate.

TABLE 3-15

EUREKA COUNTY

INDUSTRIAL EMPLOYMENT 3-YEAR/MONTHLY COMPARISON

	June			Average Annual	Percent
	1987	1988	1989	Increase	Change
Total Industries	1,330	3,110	3,610	64.8	219.5
Mining	1,120	2,260	3,010	63.9	168.8
Construction	10	660	380	516.4	3,700.0
Manufacturing	0	0	0	0	0
TCPU	20	20	20	0	0
Trade	40	40	50	11.8	25.0
Fire	10	0	0	(100.0)	(100.0)
Service	20	20	20	0	0
Government	120	110	130	4.1	8.3

Source: Nevada Employment Security Department (employment by place of work).

[1] Transportation, communications, and public utilities.

[2] Finance, insurance, and real estate.

Elko County shows an even lower unemployment rate than the state. Table 3-16 shows labor force and unemployment rates for March from 1988 to 1990. This table reflects employment by place of residence; therefore the figures represent miners working in Eureka County but living in Elko County. The unemployment rate has decreased from 5.3 percent in March 1988 to 4.6 percent in March 1990.

Although the unemployment rate appears low, many factors affect employment levels seasonally and annually. The primary influence on unemployment in Elko County is the level of immigration of out of state or out of region construction and mining related workers. As long as there is economic growth within Elko County and mining continues to expand, employment and unemployment rates will fluctuate as new workers from outside of the area enter the job force or move to the area looking for work.

3.13.3 Housing

The existing housing situation is difficult to characterize quantitatively with any degree of accuracy since conditions change almost daily. Table 3-17 shows the 1989-90 NENDA estimates of housing units for Elko, Carlin, and unincorporated Elko County. Since 1988 the permanent housing stock has increased by 1,603 units (BLM 1989; Lipparelli 1988) including 590 apartment or multi-family units and 782 mobile home units.

Developments currently under construction in Elko include Sundance Estates, Brentwood Estates, Rolling Hills, Suncrest, Juniper Hills, Adobe Heights, and Lipparelli Estates. In June 1990, 35 units were available for sale in these developments, 43 single-family lots and 225 mobile-home lots were available for development (Barss 1990). In addition to these developments, Newmont is developing three areas: Clover Hills, North Hollow, and North Estates. Barrick is developing Mountain View and North Fifth. Currently, Barrick has 37 homes under construction, with 94 additional lots available for development if the need arises (Ingersoll 1990). Barrick also anticipates that 50 apartment units will be available for construction and temporary workers during the construction phase of the project expansion (Ingersoll 1990).

The Spring Creek area outside of Elko is plotted for a total of 5,409 lots. Of this total, 3,940 are single-family lots and 1,469 are mobile-home lots. Currently 1,183 (81 percent) of the mobile-home lots are

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Developments currently under construction in Elko include Sundance Estates, Woodwood Estates, Rolling Hills, Suncrest, Juniper Hills, Adobe Heights, and Lipparelli Estates. In June 1990, 35 units were available for sale in these developments, 43 single-family lots and 225 mobile-home lots were available for development (Baron 1990). In addition to these developments, Newmont is developing three areas: Clover Hills, Hooch Hollow, and North Estates. Barrick is developing Mountain View and North Birch. Currently, Barrick has 37 homes under construction, with 84 additional lots available for development if the need arises (Ingersoll 1990). Barrick also anticipates that 50 apartment units will be available for construction and temporary workers during the construction phase of the project expansion (Ingersoll 1990).

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TABLE 3-16

ELKO COUNTY

TOTAL LABOR FORCE 3-YEAR/MONTHLY COMPARISON

	March 1988	March 1989	March 1990	Feb. 1990
Labor Force	13,230	14,980	15,930	15,700
Employment	12,370	14,090	15,020	14,780
Nonagricultural	11,710	13,430	14,180	14,050
Agricultural	660	660	840	730
Unemployment	860	890	910	930
Unemployment Rate	5.3%	4.8%	4.6%	4.3%

Source: Employment Security Department (employment by place of residence).

TABLE 3-17

EXISTING HOUSING STOCK IN ELKO COUNTY

	City of Elko	Carlin	Elko County
1989 Estimated Population[1]	18,000[2]	2,880	33,200[3]
Housing Units (1989 estimate)[1]			
Single-family	2,431	287	1,021
Apartments and Multi-family	1,537	279	690
Mobile homes	1,518	398	1,752
TOTAL	5,486	964	3,463
Rental Rates[1]			
Single-family	$500-700		
Apartment	300-650[4]	$325-450	
Multi-family	200-330[4]	150-175[5]	
Temporary Housing[1]			
Motels	1,611	17	
RV Spaces[5]	5 (parks) 1,000+	1 (park) 83	
Housing For Sale			
Single-family	64	7	45
Price Range	$45-200,000	$35-200,000	$40-200,000+
Average Price	$90,000	$72,000	

[1] NENDA 1989-1990 Profile.

[2] City of Elko, not including Spring Creek.

[3] Total population of Elko County.

[4] Telephone survey, 1990.

[5] Mountain West Community Inventory, October 1989.

[6] Listed in MLS in June 1990.

occupied and 785 (19.9 percent) of the single-family lots are occupied. Occupancy of available units at Spring Creek is high (Spring Creek Homeowners Association 1990).

According to Western Property Management Company, which manages 592 apartment units in the county, there are 485 apartments and single-family units in Elko; the current vacancy rate for rentals is estimated at 3 percent. The unoccupied units are generally being remodeled or upgraded.

The Multiple Listing Service (MLS) of the Board of Realtors showed 23 lots, 7 mobile homes, 64 houses for sale in Elko; 57 lots and 20 mobile homes for sale in Spring Creek; and 45 homes for sale in unincorporated Elko County as of June 1990. These listings do not represent the entire Elko market. Listings in the Elko Daily News (May 1990) showed 28 residential units, 19 mobile homes, and 2 mobile home lots for sale and 2 mobile homes for rent. Northern Nevada Home and Business Buyer's Guide listed 75 homes for sale (May 1990).

Elko realtors suggest that homes are typically on the market for less than 60 days (Century 21 1990; Lipparelli and Associates 1990; Kathy Algerio Real Estate 1990). As of June 1990, the tight sales market had shown signs of softening as housing supply started to catch up with demand. However, rental housing is extremely tight and demands premium rents.

Carlin represents a tighter rental housing market than Elko. There appear to be no vacant units available for rent other than RV spaces. The housing market in Carlin also appears to be softening. The MLS has listed seven homes for sale in Carlin since January 1990. In June 1990, there were an estimated 12 homes for sale (Wanda's Real Estate 1990). Single-family home prices range from $35,000 up, with the average price of a home at $65,000.

Area realtors indicate the real estate market in Elko, Carlin, and Spring Creek is considerably softer than it was a year ago. The supply of housing for sale is adequate to meet the demand. However, rental housing continues to be extremely tight with very few vacancies.

3.13.4 Public Facilities and Services

3.13.4.1 Eureka County

Police and Fire Services. The Eureka County Sheriff's Office has a staff of 18 (Community Inventory 1989) headquartered in the city of Eureka, approximately 106 miles southeast of the project site. Volunteer fire departments are located in Eureka, Pine Valley (35 miles southeast), Diamond Valley (98 miles southeast), and Beowawe (50 miles southwest). The volunteer fire department building in Crescent Valley (63 miles southwest) is currently under construction.

Emergency Response and Medical Services. There are ambulance services staffed by volunteers from Crescent Valley and Beowawe in northwestern Eureka County. A county-operated medical clinic in the town of Eureka is staffed by one doctor and one nurse.

Public Utilities. Limited information was available on public utilities in Eureka County. It is assumed that sewage is handled through individual septic systems.

The only water supply information available was from the Crescent Valley Town Board. They maintain a community well with an average flow of 300 gallons per minute. Water is stored in a 186,000-gallon tank. It is estimated that this water supply system could serve a maximum population of 200. All present homes and businesses in Crescent Valley are connected to this water supply system.

Solid Waste. There are two solid waste landfills in the northern portion of Eureka County: a 40-acre site in Crescent Valley and a 10-acre site in Beowawe. The Crescent Valley landfill has an estimated remaining life of 38 years, and the Beowawe landfill has an estimated remaining life of 9 years. The Crescent Valley landfill uses approximately 1/4-acre each year, and the Beowawe landfill uses approximately 1/8-acre each year.

Schools. There are three schools in Eureka County:

School	Fall 1989 Enrollment
Eureka High (grades 7-12)	93
Eureka Elementary (K-6 and preschool)	126
Beowawe Elementary	38

Since the Fall of 1988, the Eureka County School District has had a net gain of four students distributed among the three schools. The district employs 30 certified teachers and 23 noncertified staff members. Twenty-eight students who live in northern Eureka County are bussed to Carlin schools in Elko County. The district is currently constructing a new gymnasium and renovating the old gymnasium into classroom space at Eureka Elementary School.

In 1989, District General Fund revenues were approximately $2 million and expenditures were approximately $2.6 million.

Recreation and Library Services. Eureka County maintains a public swimming pool and a Little League baseball park in Eureka. Additionally, there is a public library in Eureka. The county fairgrounds and associated buildings are also located in Eureka.

3.13.4.2 Elko County

Police and Fire Services

Sheriff's Department. As of May 1990, the Elko County Sheriff's Department had a staff of 40 deputies, including 29 in Elko, 5 in Wendover, 4 in Jackpot, 1 in Wells, and 1 in Mountain City, and 5 administration/office personnel (Watson 1990). As of the 1989 Community Inventory, the Elko County Sheriff's Department reported three vacancies in Elko. Population growth in the Elko area has led to a significant increase in crime, causing the Sheriff's Department to be understaffed. According to Lieutenant Watson, Elko County population grew 90 percent in the past 3 years, while the Sheriff's Department grew 40 percent. During 1988, patrol/operations personnel recorded 2,287 overtime hours for the year, an average of 191 overtime hours per month (Community Inventory 1989).

As of May 1990, the Elko County Sheriff's Department had 26 marked patrol vehicles. Of these 26, 2 are assigned to the jail and 1 is used for animal control. Eleven of the 26 vehicles have over 100,000 miles, 6 have between 70,000 and 100,000 miles, and 9 are new vehicles. According to Lieutenant Watson, the Sheriff's Department needs four more vehicles.

County Jail. The Elko County Jail is located in the City of Elko. The building is 2 years old and is in excellent condition (Miller 1990). There are no plans for expansion of the facility in the next 2 years (Watson 1990). The County Jail has a staff of 14 and a prisoner capacity of approximately 115. The number of staff members is not adequate for the average daily prisoner population of 79; five new staff members are needed (Watson 1990). The County Jail is the only correctional facility in Elko County and, therefore, serves all governmental agencies in the county. Elko County maintains a short-term juvenile correctional facility in Elko and utilizes a long-term juvenile correctional facility in Humboldt County on an inter-county basis. Table 3-18 provides statistical data on the operations of the Sheriff's Department.

Fire Services. Fire services for incorporated cities in Elko County are provided by municipal fire departments. Unincorporated areas are served by the Nevada Division of Forestry and the Northeastern Fire Protection Department.

The Northeastern Fire Protection Department serves unincorporated areas of Elko and Eureka counties with 7 paid staff members and 27 volunteers. Mike Murphy of the Fire Protection Department stated that the staff is not large enough to handle its workload (Murphy 1990).

Emergency Response and Medical Services

Emergency Response. The State Emergency Medical Services office in Elko provides ambulance service to Elko County. The 20 volunteers are trained as Emergency Medical Technicians (EMTs) or Registered Nurses (RNs). Sheriff and fire services also respond to emergency calls. The ambulance service has two ambulances for Elko County. The number of calls for assistance has nearly doubled from 1988; however, only half of all calls

TABLE 3-18

INCIDENT STATISTICS

ELKO COUNTY SHERIFF'S DEPARTMENT

JANUARY THROUGH MAY 1989 AND 1990

Activity	Elko Area Jan - May 1989	Elko Area Jan - May 1990	County Jan - May 1989	County Jan - May 1990
Crimes	277	402	692	761
Incidents	254	275	689	564
Accidents	52	56	144	148
Citations	159	148	589	419
Misdemeanor Arrests	126	158	349	304
Felony Arrests	24	35	64	73
Civil	1,284	1,686	1,804	2,225
Total	2,176	2,760	4,331	4,494

Source: Elko County Sheriff's Department.

actually need ambulance or emergency response service. Approximately 400 calls were received in 1988; approximately 600 calls had been received during the first 9 months of 1989 (Community Inventory 1989).

The Barrick Goldstrike Mine has its own ambulance, which has been permitted by the State Emergency Medical Services office. Other mines have first-aid cars that do not have permits as fully operational ambulances (Community Inventory 1989).

Medical Services. The Elko General Hospital in Elko is the only full-service hospital between Reno (300 miles west) and Salt Lake City (200 miles east). It is operated by Elko County and has a staff of 215. There are 50 beds in the hospital, a 24-hour emergency room, obstetrics, surgery, and other general medical services. Recruiting for new employees is an ongoing process (Lenz 1990).

Public Utilities

Water. Elko County supplies water to unincorporated areas of the county; incorporated areas are served by private water agencies (Murphy 1990). Several different sources of water are used throughout the county, including springs and wells (Darnell 1990).

Sewage Treatment. Elko County provides sewage treatment for unincorporated areas of the county; incorporated areas are served by municipal sewage treatment services (Murphy 1990). Several different types of sewage treatment are utilized throughout the county including facultative lagoons (with and without aeration), septic systems, and disposal ponds (Darnell 1990).

Electricity. Sierra Pacific Power Company is the major supplier of electricity in Elko County. Wells Rural, Mount Wheeler Rural, Raft River Rural, and Idaho Pacific supply power to outlying rural areas of Elko County (Murphy 1990).

Natural Gas. Southwest Gas supplies to the cities of Elko and Carlin (Murphy 1990).

actually need ambulance or emergency response service. Approximately 490 calls were received in 1988; approximately 600 calls had been received during the first 9 months of 1989 (Community Inventory 1989).

The Jerritt Canyon-like Mine has its own ambulance, which has been permitted by the State Emergency Medical Services office. Other mines have first-aid cars that do not have permits as fully operational ambulances (Community Inventory 1989).

Medical Services. The Elko General Hospital in Elko is the only full-service hospital between Reno (300 miles west) and Salt Lake City (200 miles east). It is operated by Elko County and has a staff of 215. There are 50 beds in the hospital, a 24-hour emergency room, obstetrics, surgery, and other general medical services. Recruiting for new employees is an ongoing process (Lens 1990).

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Natural Gas. Southwest Gas supplies to the cities of Elko and Carlin (Murphy 1990).

Telephone. CP National is the major supplier of telephone service in Elko County, although three small telephone companies are suppliers in outlying rural areas (Murphy 1990). CP National is currently providing service to 200 new users per month and is growing at an annual rate of 10 percent (Marietta 1990).

Solid Waste. There are seven landfills in Elko County. The Spring Creek and Ryndon landfills serve rural Elko County and Carlin areas. The Spring Creek landfill is approximately 7 miles southeast of Elko. It is county-owned and has an estimated 1 to 2 years remaining before closure. There are three surface impoundment ponds for septic system disposal. Together with the City of Elko, Elko County is planning a joint venture to construct a new landfill on 640 acres of BLM land near Spring Creek (Boucher 1990). The county-owned Ryndon landfill is approximately 10 miles northeast of Elko and has approximately 10 to 20 years remaining before closure. Landfills in Elko County are under the jurisdiction of the Public Works and Road Departments. They are funded by 10 percent of the gasoline tax that is collected by the Road Department (Community Inventory 1989).

Schools

Enrollment. The Elko County School District includes 19 schools with a total enrollment in April 1990 of 7,223 students in grades kindergarten through 12 (Harris 1990). Table 3-19 lists the schools in the district which serve the Elko area population, their enrollments for 1987, 1988, and 1989, and their gain and/or loss of student population from 1988 to 1989.

The first five schools listed on Table 3-19 are Elko-area elementary schools. The Elko elementary schools have had an increase of 14.8 percent between 1988 and 1989 and an increase of 41.8 percent between 1987 and 1989. The Elko junior and senior high schools (grades 7 through 12) experienced a student population increase of 19.6 percent between 1988 and 1989 and an increase of 37.9 percent between 1987 and 1989.

The town of Carlin has one school for all grade levels. It has experienced a student population increase of 5.3 percent from 1988 to 1989 and 21.9 percent from 1987 to 1989. Enrollment has decreased by 29 students during the 1989-90 year (Melcher 1990). The new permanent Carlin

Telephone. CP National is the major supplier of telephone service to Elko County, although three small telephone companies are suppliers in outlying rural areas (Lampe, 1990). CP National is currently providing service to 220 new users per month and is growing at an annual rate of 10 percent (Barrieta 1990).

Solid Waste. There are seven landfills in Elko County. The Spring Creek and Ryndon landfills serve rural Elko County and Carlin areas. The Spring Creek landfill is approximately 7 miles southeast of Elko. It is county-owned and has an estimated 1 to 2 years remaining before closure. There are three surface impoundment ponds for septic system disposal. Together with the City of Elko, Elko County is planning a joint venture to construct a new landfill on 640 acres of BLM land near Spring Creek (Boucher 1990). The county-owned Ryndon landfill is approximately 10 miles northeast of Elko and has approximately 18 to 20 years remaining before closure. Landfills in Elko County are under the jurisdiction of the Public Works and Road Departments. They are funded by 10 percent of the gasoline tax that is collected by the Road Department (Community Inventory 1989).

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The town of Carlin has one school for all grade levels. It has experienced a student population increase of 5.5 percent from 1988 to 1989 and 22.9 percent from 1987 to 1989. Enrollment has decreased by 28 students during the 1989-90 year (Fletcher 1990). The new permanent Carlin

TABLE 3-19

ELKO COUNTY SCHOOL DISTRICT - END OF SECOND WEEK ENROLLMENT

(1989-1990)

School	1987	1988	1989	1988-1989 Gain/Loss	1988-1989 Percent of Increase/ Decrease	1987-1989 Gain/Loss	Percent of Increase/ Decrease
Elko Elementary							
Gram.ar #2	591	488	452	-36	-7.4	-139	-23.5
Mountain View	---	358	523	165	46.1	---	--
Northside	653	561	500	-61	-10.9	-153	-23.4
Southside	867	766	693	-73	-9.5	-174	-20.0
Spring Creek	---	435	827	392	90.1	---	--
TOTAL	2,111	2,608	2,995	387	14.8	884	41.9
Elko Junior and Senior High							
Elko Junior High	469	586	720	134	22.9	251	53.5
Elko Senior High	944	1,044	1,229	185	17.7	285	30.2
TOTAL	1,413	1,630	1,949	319	19.6	536	37.9
Carlin							
Carlin Combined	411	473	501	25	5.3	90	21.9
Other Elko County Schools							
Owyhee Combined	308	331	362	31	9.4	54	17.5
Wells Combined	396	411	429	18	4.4	33	8.3
Jackpot Combined	235	255	256	1	0.4	21	8.9
West Wendover Elementary	450	479	524	45	9.4	74	16.4
Currie	7	8	8	0	0.0	1	14.3
Independence Valley	17	11	15	4	36.4	-2	-11.8

TABLE 3-19 (CONTINUED)

School	1987	1988	1989	1988-1989 Gain/Loss	1988-1989 Percent of Increase/ Decrease	1987-1989 Gain/Loss	Percent of Increase/ Decrease
Jarbidge	9	5	3	-2	-40.0	-6	-66.6
Montello	27	19	26	7	36.8	-1	-3.7
Mound Valley	11	10	13	3	30.0	2	18.2
O'Neil	8	3	3	0	0	-5	-62.5
Ruby Valley	39	34	35	1	2.9	-4	10.3
Total District-wide	5,442	6,277	7,118	841	13.4	1,676	30.8

Source: Elko County School District.

Combined school is not presently overcrowded (McKelly 1990). A new elementary school is under construction in Carlin (Community Inventory 1989). The district-wide increase for all grade levels was 13.4 percent between 1988 and 1989 and 30.8 percent between 1987 and 1989.

Table 3-20 lists the schools in Elko and Carlin and provides the capacity and current enrollment of each. Elko junior and senior high Schools (grades 7 through 12) have lost 10 students between September 1989 and April 1990. The five Elko elementary schools have had an increase of 124 students in the same period (Harris 1990).

Staffing. The Elko County School District employed a total of 564 staff members in the 1988-89 school year compared to 498 in the 1987-88 school year, an increase of 13.3 percent. As of April 1990, Elko County School District employed staff of 650 (Harris 1990).

Parents' Occupations. According to Elko County Assemblyman John Carpenter, the parents of 1,644 Elko County students worked in Eureka County during the 1988-89 school year (Elko Daily, October 1989). Of the 750 new students who came to the district between June 1989 and September 1989, 247 were children of families employed in mining (Harris 1990).

School Transportation. Of the 6,277 students in the Elko County School District in 1988-89, an average of 1,938 were bussed to and from school daily, compared to 1,334 students per day in the 1987-88 school year, an increase of 45.3 percent. Approximately 173 students are bussed out of Elko County daily to schools in adjacent counties, while 343 students from adjacent counties are bussed into Elko County. Approximately 40 students are bussed to Carlin Combined. The district maintains 51 busses, ranging in size from 12-passenger to 84-passenger (Community Inventory 1989).

School District Revenues and Expenditures. Table 3-21 provides estimated year-end revenues and expenditures for the school years 1984-85 to 1988-89. A pay-as-you-go school construction tax was approved by voters in Elko County in March 1989. The tax increase will cost taxpayers approximately 17 cents in additional taxes (bringing the total school tax

TABLE 3-20

IMPACT AREA SCHOOLS, CAPACITY AND ENROLLMENT, 1989

School		Current Enrollment[1]	Capacity
Elko High	(9-12)	1,167	1,200
Elko Junior High	(7-8)	772	600
Spring Creek	(K-6)	880	650
Southside	(K-6)	718	650
Grammar School #2	(K-6)	475	510
Northside	(K-6)	496	550
Mountain View	(K-6)	550	660
Carlin Combined	(K-12)	475	525

Source: Harris 1990.

[1]As of April 1990.

TABLE 3-21

ELKO COUNTY SCHOOL DISTRICT REVENUES AND EXPENDITURES

School Year	Year-End Estimated Revenues	Expenditures
1984-1985	$11,712,247	$12,053,441
1985-1986	$14,512,161	$14,543,173
1986-1987	$16,515,767	$16,428,537
1987-1988	$19,453,154	$19,162,286
1988-1989	$23,218,304	$22,986,202

Source: Community Inventory 1989.

assessment to 70 cents) per $100 of assessed valuation for the next 2 years. In 1992, when a previously passed 25-cent pay-as-you-go tax expires, the total school assessment will drop slightly to 69.87 cents. In 1993, when a 28-cent school bond levy expires, the assessment will drop to 50 cents. The construction tax passed in March 1989 will expire in 1999, but can be dropped at any time if the growth in the school system should decline (Elko County 1989).

The projected 1990-91 general operating budget for the Elko County School District is $33,851,591, an increase of 46 percent over the 1988-89 revenues. Local sources (ad valorem taxes) will provide 42 percent of the projected budget; 50 percent will be provided by the State of Nevada; and 8 percent will be provided by federal funds for federal-land impacts to state and local governments (Harris 1990).

The State of Nevada per-student appropriation for Elko County is $3,343 for the 1989-90 school year and will be $3,419 for the 1990-91 school year. The state has a statute allowing school districts to impose a development fee for new development within the district. However, Elko County School District has not enacted this fee (Harris 1990).

The Nevada Legislature has recently approved Assembly Bill 752, which levies a 50-cent per $100 assessed valuation on Eureka County mines to be paid to Elko County. AB 752 takes effect on July 1, 1990 for a period of 3 months. At that time, Eureka County voters will be asked to approve this pay-as-you-go tax on a permanent basis. Elko County expects to receive as much as $500,000 during the July to September 1990 period (Harris 1990).

Recreation and Library Services

Recreation. Recreation services in Elko County are under the jurisdiction of either municipal recreation departments, private groups, or the Elko Area Recreation Commission (EARCO). Until recently, EARCO had been primarily involved with maintaining parks. Private groups, such as softball leagues and homeowner's associations, have organized recreational activities (Hoffman 1990).

Currently, EARCO is interviewing applicants for a new position of Recreation Superintendent for a combined Recreation District in the City of Elko and unincorporated Spring Creek. The new Recreation District will

assessment is 78 cents per $100 of assessed valuation for the next 2 years. In 1992, when a previously passed 25-cent pay-as-you-go tax expires, the local school assessment will drop slightly to 69.67 cents. In 1993, when a 28-cent school bond levy expires, the assessment will drop to 30 cents. The construction tax passed in March 1988 will expire in 1999, but can be dropped at any time if the growth in the school system should decline (Elko County 1989).

The projected 1990-91 general operating budget for the Elko County School District is $22,951,591, an increase of 26 percent over the 1988-89 revenues. Local sources (ad valorem taxes) will provide 42 percent of the projected budget; 50 percent will be provided by the State of Nevada; and 8 percent will be provided by federal funds for federal-land impacts to state and local governments (Harris 1990).

The State of Nevada per-student appropriation for Elko County is $3,343 for the 1989-90 school year and will be $3,419 for the 1990-91 school year. The state has a statute allowing school districts to impose a development fee for new development within the district. However, Elko County School District has not enacted this fee (Harris 1990).

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Currently, EARCO is interviewing applicants for a new position of Recreation Superintendent for a proposed Recreation District in the City of Elko and unincorporated Spring Creek. The new Recreation District will

operate a summer recreation program in 1990 for children ages 6 to 13. The program will be funded by Dee Gold Company (Hoffman 1990).

Library Services. The Elko County Library serves 32,311 people in Elko, Eureka, White Pine, and Lander Counties (Community Inventory 1989). The main library is in the City of Elko. There are 7 branch libraries which are staffed on a part-time basis. The county also maintains two bookmobiles to service outlying areas in Elko, Lander, and White Pine counties. Circulation is estimated at 160,000 volumes per year, an average of five volumes per person per year in the four-county area. No expansion is planned for the main library.

3.13.4.3 City of Elko

Police and Fire Services

Police. The Elko City Police Department has a staff of 26 patrol and investigative officers, 1 animal control officer, 5 administrative/ clerical staff, and 9 communications personnel. The Police Department plans to hire an additional officer in July 1990. At that time, the staff will be adequate to serve the current population (Kirby 1990). The Police Department serves the incorporated limits of the City of Elko.

The City of Elko does not have a correctional facility but uses the Elko County Jail. The Police Department is housed in a 7,500-square-foot building in good condition (Community Inventory 1989).

Fire Services. The Elko Fire Department has 12 paid firefighters and 18 volunteers housed in two fire stations in the City. The Department needs to hire three more paid firefighters and recruit two more volunteers to adequately serve the current population (Debbie 1990). The Fire Department maintains seven pumper/firetrucks. The Department has a Fire Insurance Rating of 5.

The Fire Department serves the City of Elko and a 5-mile outlying radius as mutual aid with the Nevada Division of Forestry. In addition, cooperative agreements for mutual aid are maintained with the Carlin Fire Department, the Wells Fire Department, and the Elko County Fire Department.

Emergency Response and Medical Services. Several agencies provide emergency response services in the Elko area, including the Elko Fire Department, the Elko Police Department, the Elko County Sheriff, the Nevada Highway Patrol, the Nevada Division of Forestry, the State Ambulance Service, and the Bureau of Land Management. Mutual aid between agencies is practiced in this area.

The Elko Fire Department has 23 staff members trained as Emergency Medical Technicians (EMTs). Fifteen staff members are trained to handle chemical spills, and 15 are trained to handle radioactive materials. An emergency evacuation plan is currently being formulated for the City of Elko. Medical services in the City of Elko are provided by Elko General Hospital which is operated by Elko County.

Public Utilities

Water. Water is supplied by municipal wells operated by the City of Elko (Darryl 1990). The connection charge for new residential users is $725; monthly charge is $14.50. New commercial and industrial users are charged by the same formula for water connection. The municipal waterworks budget for the fiscal year ending June 30, 1990, estimates an operating revenue (from user fees) of $1,161,000 and operating expenses of $1,143,700 and an expected net income of $33,703.

Sewer Service. Sewer service is provided by the City of Elko to all residential, commercial, and industrial users within the incorporated city limits. The sewage treatment plant was recently expanded and is adequate for the current population (Darryl 1990). Effluent is pumped to percolation ponds; some water is reclaimed for irrigation.

The connection charge for new residential users is $1,500 (50 minimum sewer fixture units x $30). New commercial and industrial users are charged 75 minimum sewer fixture units for sewer connection. The monthly charge for residential users is $5.25.

The municipal sewer budget for the fiscal year ending June 30, 1990 estimates operating revenues (from user fees) of $995,500, operating expenses of $857,956, and a net income of $3,110.

Emergency Response and Medical Services. Several agencies provide emergency response services in the Elko area, including the Elko Fire Department, the Elko Police Department, the Elko County Sheriff, the Nevada Highway Patrol, the Nevada Division of Forestry, the State Ambulance Service, and the Bureau of Land Management. Mutual aid between agencies is practiced in this area.

The Elko Fire Department has 21 staff members trained as Emergency Medical Technicians (EMTs). Fifteen staff members are trained to handle chemical spills, and 15 are trained to handle radioactive materials. An emergency evacuation plan is currently being formulated for the City of Elko. Medical services in the City of Elko are provided by Elko General Hospital which is operated by Elko County.

Public Utilities

Water. Water is supplied by municipal wells operated by the City of Elko (Darryl 1990). The connection charge for new residential users is $720; monthly charge is $14.50. New commercial and industrial users are charged by the same formula for water connection. The municipal waterworks budget for the fiscal year ending June 30, 1990, estimates an operating revenue (from user fees) of $1,191,000 and operation expenses of $1,143,700 and an expected net income of $41,703.

Sewer Service. Sewer service is provided by the City of Elko to all residential, commercial, and industrial users within the incorporated city limits. The sewage treatment plant was recently expanded and is adequate for the current population (Darryl 1990). Effluent is pumped to percolation ponds; some water is reclaimed for irrigation.

The connection charge for new residential users is $1,500 (50 minimum sewer fixture units x $30). New commercial and industrial users are charged 75 minimum sewer fixture units for sewer connection. The monthly charge for residential users is $5.25.

The municipal sewer budget for the fiscal year ending June 30, 1990 estimates operating revenues (from user fees) of $297,500, operating expenses of $264,385, and a net income of $33,115.

Solid Waste. Disposal service for the City of Elko is provided by Elko Sanitation Company. The City of Elko operates a 130-acre municipal sanitary landfill. The landfill is funded from the General Fund, and users are charged a fee. Currently, over half the site remains to be used; closure is anticipated in 7 years. The landfill serves an estimated city and county population from 25,000 to 28,000 (Kline 1990).

Schools. See Schools in Section 3.13.4.2, Elko County.

Municipal Airport. The Elko Municipal Airport serves the northern Nevada area between Reno and Salt Lake City. The airport is funded by the city from governmental and expendable trust funds. There are 11 public flights daily as well as private flights. The city is allocating funds for future airport expansion, but plans for expansion are not firm (Murphy 1990).

Recreation and Library Services

Recreation. The City of Elko maintains a budget for recreation and golf. The city does not have a recreation department, but maintains its parks with a portion of the room tax revenues collected. The municipal golf course is supported by user fees (Murphy 1990).

Library. The Elko County Library serves the City of Elko.

3.13.4.4 Community of Carlin

Police and Fire Services

Police. The Carlin Police Department has six sworn officers, four nonsworn staff members, and three reserves. They patrol the 2-mile by 2-mile town limits and respond to calls within a 5-mile radius of town. The department has five patrol vehicles, two of which are 1989 models with less than 10,000 miles registered. The department also has a pickup truck used for animal control. Present staff levels are adequate to serve the current population but will not be adequate if the population continues to increase (Kranovich 1990).

The Carlin Police Department is cross-deputized to assist both the Eureka County Sheriff and the Elko County Sheriff. They also assist the Nevada Department of Prisons (providing assistance to the Honor Camp located north of the area), Nevada Highway Patrol, Nevada Fish and Game, and the Southern Pacific Railroad. Additionally, the Carlin Police Department handles theft reports from local mines (Community Inventory 1989; however, the percentage of calls from the mines is very small (Kranovich 1990).

Prisoners from Carlin are housed at the Elko County Jail in Elko. The Carlin Police Department is currently housed in an old 800-square-foot building. Planning is underway to either add to the building (at a cost of $18,000) or construct a new building (at a cost of $250,000) within the next year. Funds for the building improvement are being donated (Kranovich 1990).

Fire Services. The Carlin Fire Department is a volunteer fire department with 26 volunteers; 19 are trained as EMTs, 1 is a Registered Nurse, 1 is a Licensed Practical Nurse, and 2 are First Responders (Togurelli 1990). The primary service area for the Carlin Fire Department is the Town of Carlin, although the department also provides service for a distance of 12 miles to the east, 25 miles west to the town of Dunphy, 60 to 70 miles to the south, and 50 or more miles to the north to serve area mines. A mutual aid agreement is in effect with the Nevada Division of Forestry, the State Fire Agency, and all of the fire departments in Elko and Eureka counties.

The department maintains three fire trucks, two ambulances, and an additional vehicle for rescue operations. The department has a Fire Insurance rating of 7.

The department needs to increase its staffing due to increased calls for service in recent years, but they have found it difficult to find volunteers, especially during daytime hours (Community Inventory 1989). Service calls have doubled since 1988 due to mining expansion (Togurelli 1990). Fifty percent of the calls in April 1990 were for ambulance service to the mines (Togurelli 1990).

Emergency Response and Medical Services. Emergency response activities in the City of Carlin are under the jurisdiction of the Carlin

The Carlin Police Department is cross-deputized to assist both the Eureka County Sheriff and the Elko County Sheriff. They also assist the Nevada Department of Prisons (providing assistance to the Honor Camp located north of the area), Nevada Highway Patrol, Nevada Fish and Game, and the Southern Pacific Railroad. Additionally, the Carlin Police Department handles theft reports from local mines (Community Inventory 1989); however, the percentage of calls from the mines is very small (Kosmovich 1990).

Prisoners from Carlin are housed at the Elko County Jail in Elko. The Carlin Police Department is currently housed in an old 800-square-foot building. Planning is underway to either add to the building (at a cost of $25,000) or construct a new building (at a cost of $250,000) within the next year. Funds for the building improvement are being donated (Kosmovich 1990).

Fire Services. The Carlin Fire Department is a volunteer fire department with 24 volunteers; 19 are trained as EMTs, 1 is a Registered Nurse, 1 is a Licensed Practical Nurse, and 2 are First Responders (Topurelli 1990). The primary service area for the Carlin Fire Department is the Town of Carlin, although the department also provides service for a distance of 12 miles to the east, 25 miles west to the town of Dunphy, 50 to 70 miles to the south, and 50 or more miles to the north to serve area mines. A mutual aid agreement is in effect with the Nevada Division of Forestry, the State Fire Marshal, and all of the fire departments in Elko and Eureka counties.

The department maintains three fire trucks, two ambulances, and an additional vehicle for rescue operations. The department has a Fire Insurance rating of 7.

The department needs to increase its staffing due to increased calls for service in recent years, but they have found it difficult to find volunteers, especially during daytime hours (Community Inventory 1989). Service calls have doubled since 1987 due to mining expansion (Topurelli 1990). Fifty percent of the calls in April 1990 were for ambulance service to the mines (Topurelli 1990).

Emergency Response and Medical Services. Emergency response activities in the City of Carlin are under the jurisdiction of the Carlin

Fire Department and the Carlin Police Department. Ten of the EMTs have First Responder training for chemical spills and radioactive material incidents. There is no local evacuation plan in effect for Carlin.

Medical services for Carlin are provided by the Elko General Hospital in Elko, 23 miles to the east.

Public Utilities

Electricity. Wells Rural Electric Company provides electricity for Carlin from the Bonneville power plant, a hydroelectric plant near Wells. Wells Rural Electric has not experienced any strain on its capacity and does not anticipate any (Johnston 1990).

Water. Carlin gets its water from a municipal well which supplies an average of 1,200 gallons per minute and Arthur Springs which supplies an average of 800 gallons per minute. It is estimated that the existing water supply could serve a population of 5,000. Present population is 2,750 (Ariazzi 1990).

The water treatment system currently treats an average of 800,000 gallons per day with an average treatment capacity of 2,900,000 gallons per day. The treatment system is in good condition, with no plans for renovation or expansion (Community Inventory 1989). An upgrading of the water system and water lines was completed within the last 10 years, funded in part by Community Development Block Grants and donations from the local mines.

Current water rates are $12 per month for residential users and from $12 to $36 per month for commercial and industrial users. Agricultural users pay $6 per month. Developers are partially responsible for the cost of new water system installations.

Sewer Service. Carlin maintains a sewage treatment system that serves 95 percent of the residences and 100 percent of the commercial and industrial facilities within the central community. The system is an aerated lagoon with liquid disposal through rapid infiltration basins and sludge disposal at the city-operated sanitary landfill. The system is designed for a maximum population of 3,500.

Carlin is in the process of completing a $1.2 million sewer expansion project. Approximately 71 percent of the funding for the project came from the Environmental Protection Agency (Community Inventory 1989). Other funding was provided by Community Development Block Grants and donations from local mines.

User fees range from $13.50 per month for residential users and from $13.50 to $40.50 per month for commercial and industrial users. Developers pay for extending the sewer system into new areas.

Solid Waste. Carlin operates an 80-acre municipal sanitary landfill north of the city limits. Because less than half an acre is filled each year, it is anticipated that the service life of the landfill is quite lengthy (Community Inventory 1989).

The community provides trash collection services to its residents and commercial and industrial facilities. User fees are $10.50 per month for weekly collection for residential users and $10.50 plus a specified unit rate for weekly collection for commercial and industrial facilities.

Schools. See Schools in Section 3.13.4.2, Elko County.

Recreation and Library Services

Recreation. Carlin maintains a 32-acre city park, which has a playground, tennis courts, basketball courts, a baseball field, a concession stand, and bleachers. There is an additional 1.6-acre baseball field, concession stand, and bleachers in the city. Long-range plans include a proposed municipal swimming pool, golf course or putting green, an additional baseball field, and an additional playground. Land has been donated for the swimming pool, but other expansion funding has not been identified.

There are no user fees for recreation services and parks, although organized sports teams share in the cost of electricity. Local room tax revenues are earmarked for park acquisition.

Library Services. The Elko County Library serves Carlin, although there is no branch library in Carlin. The main branch of the County

Library is in Elko, 23 miles to the east. There is also a branch library in Beowawe, 26 miles to the west, in Eureka County.

3.13.5 Government and Public Finance

The primary governing bodies in Elko County include the county administration (Commissioners and Planning Commissions), the school district, the City of Elko, and the Town of Carlin. The three Elko County Commissioners oversee county operations which include roads, sheriff, judicial, assessor, clerk, and recorder, and library services. The school district is governed by an elected board which administers schools and support services for the county. The Eureka County Commissioners oversee the operations of all governmental services including roads, judicial, and public safety.

The City of Elko and Town of Carlin are each administrated by a mayor and council. The cities provide public services and facilities in the areas of streets and roads, sanitation, water, police, fire, cemetery, and parks and recreation.

Financial resources of the project area refer to government revenue sources and expenditures in Elko County and Eureka County. These statistics are useful in helping to determine the financial impacts of industrial development on the counties and local communities.

From 1985 to 1989, assessed value has increased dramatically. The average annual increase in assessed value for Elko County was 10.4 percent, 6.1 percent for the City of Elko, 14.1 percent for the Town of Carlin, and 59.1 percent for Eureka County during this 4-year period. This can be attributed to the overall growth in mining development and associated growth of residential and commercial properties. Assessed value is expected to continue to grow at a steady pace until 1991 or 1992 when mining activity is expected to level off (Nevada State Demographer 1990). Table 3-22 shows assessed valuation for Elko County, Eureka County, and the cities of Elko and Carlin.

3.13.5.1 <u>Elko County</u>. Revenues and expenditures for Elko County have been examined over the fiscal period 1985 to 1990. The budget figures presented in the text and Table 3-23 have not been adjusted to constant dollars. It is estimated that the national consumer price index during this period averaged 3.1 percent from 1984 through 1987 and 4.8 percent

Library is in Elko, 23 miles to the east. There is also a branch library in Beowawe, 26 miles to the west, in Eureka County.

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TABLE 3-22

ASSESSED VALUATION OF JURISDICTION

($000)

	Tax Rate/ $100 Assessed Value	Fiscal Year 1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	% Inc.	Average Annual Inc.
Elko County	2.2212	360,426	388,480	424,982	444,747	534,814	48.3	10.4
Elko	2.9296	106,457	112,133	118,132	120,728	134,833	26.7	6.1
Carlin	2.6434	6,947	6,349	7,309	9,587	11,758	69.3	14.1
Eureka County	1.5500	72,903	112,085	188,782	234,634	421,992	478.8	55.1

Net Proceeds of Mines
($000)

	Fiscal Year 1985-1986	1986-1987	1987-1988	1988-1989	1989-1990		
Eureka County			100,000	130,000	220,000	120.0	48.3
Elko County			41,000	41,000	92,000	124.4	49.8

Source: Nevada Department of Taxation, Local Government Division.

TABLE 3-23

ELKO COUNTY REVENUES AND EXPENDITURES ANALYSIS
1985-1986 TO 1989-1990
($000's)

	1985-1986 Actual	1986-1987 Actual	1987-1988 Actual	1988-1989 Estimated	1989-1990 Budget	1989-1990 Percentage	Average Annual Percent (Decrease)
Revenues							
Taxes: Property	936	1,472	2,616	2,242	3,553	26.6	39.6
Other	529	404	13	1,064	1,449	10.9	28.6
Licenses, Fees, Permits	448	487	572	587	549	4.0	5.2
Intergovernmental	3,752	4,200	4,640	5,258	5,678	42.6	10.9
Charges for Services	541	525	919	948	837	6.3	11.5
Fines and Forfeits	948	601	606	742	651	4.9	(9.0)
Miscellaneous	386	932	951	644	621	4.7	12.6
TOTAL	7,540	8,623	10,317	11,483	13,339	100.0	15.3
Expenditures							
General Government	2,472	2,273	2,447	2,801	5,821	30.4	23.9
Judicial	552	582	648	930	1,202	6.3	21.5
Public Safety	2,453	5,418	2,477	2,187	2,970	15.5	4.9
Public Works	1,208	1,327	1,180	1,550	5,922	30.9	48.8
Health	84	84	85	90	90	0.5	1.7
Welfare	389	419	462	660	1,175	6.1	31.8
Culture and Rec.	648	1,223	924	810	1,034	5.4	12.4
Community Support	135	133	125	140	131	.7	(.8)
Contingencies					291	1.5	
Airports	416	806	168	785	0		23.6
Debt Service: Principal Retirement		185	190	200	215	1.0	—
Interest Cost		475	345	333	320	1.7	—
TOTAL EXPENDITURES	8,357	12,918	9,051	10,484	19,170	100.0	23.1

Source: Nevada Department of Taxation.

from 1987 to June 1989 (Federal Reserve Bank of St. Louis 1990). Based on Table 3-23, it appears that overall, Elko County revenues and expenditures increased at a rate considerably higher than the national rate. These increases are a result of the dramatic growth currently occurring in Elko County from mining exploration and production.

Revenues. Intergovernmental resources include federal, state, and local sources of funds including motor vehicle tax, gas tax, and basic city/county relief sales tax. These sources have consistently provided a substantial majority of revenues to Elko County. In 1989 to 1990, these revenues are expected to represent approximately 43 percent of total revenue. The next most important source of revenues generated in the county were from property tax (26.6 percent), other taxes (10.9 percent), and charges for services (6.3 percent).

Revenue sources showing the greatest growth throughout the 1985-86 to 1989-90 period included property taxes, which were up 270 percent, and other taxes, such as sales tax, which were up 174 percent. The only area showing a decline was fines and forfeits, which were down 31.3 percent. Average annual growth throughout the period was substantial. Overall revenues grew at an average annual rate of 15.3 percent, with property taxes averaging 39.6 percent, and other taxes averaging 28.6 percent. These large increases in property taxes come from increases in net proceeds revenues and taxes associated with additional mining and development related activity throughout the county. However, over the 5-year period, expenditures have grown at a faster average rate (23.1 percent) than revenues (15.3 percent). The difference in growth rates between revenues and expenditures reflects the disparity between mining impacts in Elko County and the mining revenues generated in Eureka County. One way to facilitate a better balance between revenues and expenditures would be a more equitable distribution of city and county sales taxes generated in Elko County. Currently only 45 percent of sales and use taxes generated in Elko County return to Elko County (Ritter 1990).

Expenditures. General fund expenditures are grouped into four major categories: 1) general government, 2) public safety, 3) judicial, and 4) public works. General government includes executive functions, finance, assessor, and building and grounds. General government expenditures

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Revenues. Intergovernmental resources include federal, state, and local sources of funds including motor vehicle tax, gas tax, and basic city/county relief sales tax. These sources have consistently provided a substantial majority of revenues to Elko County. In 1989 to 1990, these revenues are expected to represent approximately 45 percent of total revenue. The next most important source of revenues generated in the county were from property tax (36.6 percent), other taxes (10.9 percent), and charges for services (6.3 percent).

Revenue sources showing the greatest growth throughout the 1985-86 to 1989-90 period included property taxes, which were up 270 percent, and other taxes, such as sales tax, which were up 174 percent. The only area showing a decline was fines and forfeits, which were down 31.3 percent. Average annual growth throughout the period was substantial. Overall revenues grew at an average annual rate of 15.3 percent, with property taxes averaging 39.8 percent, and other taxes averaging 28.6 percent. These large increases in property taxes come from increases in net proceeds revenues and taxes associated with additional mining and development related activity throughout the county. However, over the 5-year period, expenditures have grown at a faster average rate (28.1 percent) than revenues (15.3 percent). The difference in growth rates between revenues and expenditures reflects the disparity between mining impacts in Elko County and the mining revenues generated in Eureka County. One way to facilitate a better balance between revenues and expenditures would be a more equitable distribution of city and county sales taxes generated in Elko County. Currently only 40 percent of sales and use taxes generated in Elko County return to Elko County (Bitter 1990).

Expenditures. General fund expenditures are grouped into four major categories: 1) general government, 2) public safety, 3) judicial, and 4) public works. General government includes executive functions, finance, assessor, and building and grounds. General government expenditures

accounted for a projected 30.4 percent of expenditures in fiscal year 1989-90. Expenditures in this area increased an average of 23.9 percent annually. Public works represented 30.9 percent of total expenditures in 1989-90 and grew at an average annual rate of 48.8 percent. Much of this growth occurred in improvements to highways and streets. Public works showed the greatest increase in expenditures. Public safety represents 15.5 percent of total expenditures, but has only grown at an average annual rate of 4.9 percent from 1985 to 1989. There have been major fluctuations in annual expenditures in the Public Safety Department. Current requests by the department for additional patrol vehicles to meet service requirements cannot be met with this year's budget. Overall, Elko County budget constraints appear severe, particularly in public safety. Other areas of growth include increases in welfare expenditures averaging 31.8 percent growth annually. Welfare represents 6.1 percent of the general fund budget.

If distribution of sales tax revenues is not changed in fiscal year 1990-91, Elko County will likely experience budget cuts and layoffs. The fiscal condition of the county is weak due to inadequate revenues necessary to meet budgetary demands (Ritter 1990).

The assessed valuation for Elko County for 1989-90 is $534,814,009. Nevada state statutes limit indebtedness to 10 percent of assessed valuation. To date, Elko County has approximately $4,030,000 in outstanding general obligation bonds and $161,400 in other general obligation debt. The debt margin is therefore $49,290,001.

3.13.5.2 City of Elko

Revenues. The City of Elko receives operating revenues through five major sources: 1) taxes (property, room, and supplemental city/county relief tax), 2) licenses, fees, and permits, 3) intergovernmental transfers (base city/county relief tax, gas tax, motor vehicle tax, etc.), 4) fines and forfeits, and 5) charges for current services. In 1989-90, intergovernmental revenues are projected to represent the largest component (53.2 percent) of revenues. The other revenues shown in Table 3-24 represent a much smaller portion of overall revenues.

TABLE 3-24

CITY OF ELKO REVENUE AND EXPENDITURE ANALYSIS
1985-1986 TO 1989-1990

	1985-1986 Actual	1986-1987 Actual	1987-1988 Actual	1988-1989 Estimated	1989-1990 Budgeted	1989-1990 Percentage	Average Annual % Increase (Decrease)
Revenues							
Property Taxes	$ 259,089	$ 275,943	$ 368,683	$ 401,541	$ 482,889	6.5	16.8
Other Taxes	375,832	460,541	584,245	642,000	805,000	10.8	21.1
Licenses and Permits	446,244	472,580	555,503	638,650	661,650	8.9	10.3
Intergovernmental Resources	2,467,576	2,472,549	3,013,456	3,294,839	3,956,174	53.2	12.5
Charges for Services	218,855	242,916	338,203	389,000	488,000	6.6	22.2
Fines and Forfeits	48,492	63,154	65,723	70,000	80,000	1.0	13.3
Miscellaneous	959,195	969,360	1,470,737	1,487,548	963,780	13.0	11.9
TOTAL REVENUES	$4,774,283	$4,957,043	$6,396,550	$6,923,578	$7,437,493	100.0	11.7
Expenditures-Expenses							
General Government	$ 454,175	$ 380,702	$ 386,195	$ 429,537	$ 498,059	3.9	2.3
Judicial	49,674	51,328	51,878	60,000	65,450	.5	7.1
Public Safety	1,574,443	1,759,849	1,920,888	2,257,333	2,791,797	21.7	15.4
Public Works	984,211	967,228	941,663	1,567,648	5,698,223	44.4	55.1
Sanitation	112,310	64,176	155,309	294,691	256,750	2.0	27.8
Health		21,546	27,990	36,250	43,100	0.3	
Welfare	10,500	0	7,500	12,500	12,500	0.1	4.5
Culture and Recreation	587,654	615,211	743,303	772,500	1,214,150	9.5	19.9
Community Support	100,000	7,500	0	100,000	52,155	.4	—
Intergovernmental Expenditures	282,689	287,053	306,633	300,000	270,000	2.1	(1.1)
Contingencies					160,000	1.2	—
Airports	66,106	64,836	101,984	154,650	202,400	1.6	32.3
Other Enterprises	413,436	505,562	1,223,582	606,000	1,388,000	10.8	35.4
Debt Service: Principal Retirement		350,000	369,000	19,000	163,952	1.3	—
Interest Cost	50,674	32,913	33,445	13,965	25,416	.2	—
TOTAL EXPENDITURES-EXPENSES	$4,685,872	$5,107,904	$6,269,370	$6,624,074	$12,841,952	100.0	28.7

Over the period of 1985-86 to 1989-90, overall revenues have grown at an average annual rate of 11.7 percent. The largest average growth rates are in charges for services - 22.2 percent; other taxes - 21.1 percent; and property taxes - 16.8 percent.

Expenditures. Total operating expenditures increased from $4.7 million in 1985-86 to $12.8 million in 1989-90. This was a 174 percent increase, compared to a growth in revenues of 56 percent and a growth in population of 80 percent. The City of Elko is particularly affected by the growth of the mining industry in Elko and Eureka counties. The city is experiencing the majority of population-related impacts resulting from mining activity, but has had to rely heavily on mine company contributions to meet infrastructure needs. The majority of property tax and net proceeds tax allocations go to Eureka County. The state formula for sales tax distribution is inadequate to maintain proper levels of public services and facilities in the City of Elko. From 1985-86 to 1989-90, the average annual growth in expenditures in Elko was 28.7 percent compared to revenue growth of 11.7. In 1989-90, the public works budget increased by 263 percent from the previous year. Public works represented 44.4 percent of the general fund budget. The large increase in public works expenditures is for the sewer treatment plant expansion and road construction.

Other departments represented a much smaller portion of the overall budget. Public safety represented 24.7 percent and has grown at an average annual rate of 15.4 percent over the period. Culture and recreation represents 9.5 percent of the budget and has grown at a rate of 19.9 percent, and general government represents 3.9 percent of the total budget and has grown at a rate of 2.3 percent.

The 1989-90 assessed valuation for Elko was $134,833,152; bonded indebtedness is limited to 30 percent of the total assessed valuation. Elko has $159,000 outstanding for a general obligation bond, with a debt margin of $40,290,946. Unsold authorized general obligation bonds total $2.5 million. Other outstanding debts, such as short-term borrowing or warrants, is restricted to 20 percent of assessed value. Other outstanding general obligation debt is $530,597 leaving a debt margin of $26,436,033.

3.13.5.3 Town of Carlin

Revenues. The Town of Carlin receives operating revenues through four major sources: 1) taxes (property and supplemental city/county relief tax), 2) licenses, fees, and permits, 3) intergovernmental transfers (base city/county relief tax, gas tax, motor vehicle tax, etc.), 4) fines and forfeits, and 5) charges for current services. Intergovernmental resources represent the largest portion of revenues. In 1989-90, these revenues represent over 72 percent of total revenues in Carlin. The other revenues shown in Table 3-25 represent a much smaller portion of overall revenues.

During the period, revenues have grown at an average annual rate of 16.4 percent. The average growth rate has ranged from a negative 1.6 percent for property taxes to 23.8 percent for licenses and permits. Table 3-25 shows revenues and expenditures for general fund activities from 1985-86 through 1989-90.

Expenditures. Total operating expenditures in Carlin increased from $367,282 in 1985-86 to $922,207 in 1989-90 for a 151 percent increase, compared to growth in revenues of 83.6 percent. Like Elko, Carlin is significantly affected by the growth of the mining industry in Elko and Eureka counties. As in Elko, Carlin receives limited revenues from mine-related property tax and net proceeds revenues, therefore Carlin is increasingly dependent on intergovernmental revenues or mine company contributions to accommodate mine-related impacts. The state formula for sales tax distribution is inadequate to maintain proper levels of public services in the Town of Carlin.

During the period 1985-86 to 1989-90, the average annual growth in expenditures was 28.8 percent compared to 16.4 percent for revenues. All divisions of local government showed increases in expenditures. Public works has increased an average of 36.4 percent annually; public safety 24.5 percent; cultural and recreation 28.6 percent; and general government 19.1 percent.

The 1989-90 assessed valuation for Carlin was $11,040,106; bonded indebtedness is limited to 30 percent of the total assessed valuation. Carlin has no outstanding general obligation bonds, therefore the city's debt margin is $3,312,032. Carlin's other outstanding general obligation debt is $238,654 which leaves a debt margin of $1,969,367.

TABLE 3-25

TOWN OF CARLIN REVENUE AND EXPENDITURE ANALYSIS
1985-1986 TO 1989-1990

	1985-1986 Actual	1986-1987 Actual	1987-1988 Actual	1988-1989 Estimated	1989-1990 Budgeted	1989-1990 Percentage	Average Annual % Increase (Decrease)
Revenues							
Property Taxes	$ 49,680	$ 52,350	$ 60,844	$ 45,700	$ 46,600	6.9	(1.6)
Other Taxes	13,209						
Licenses and Permits	21,036	30,842	77,871	83,900	49,400	7.3	23.8
Intergovernmental Resources	241,607	289,311	331,017	385,800	494,800	72.8	19.6
Charges for Services	4,866	5,553	11,165	9,800	9,800	1.4	19.1
Fines and Forfeits	8,789	5,853	13,670	16,000	16,200	2.4	16.5
Miscellaneous	31,094	58,372	36,553	73,368	63,000	9.2	19.3
TOTAL REVENUES	$370,281	$442,281	$531,120	$614,568	$679,800	100.0	16.4
Expenditures-Expenses							
General Government	$111,065	$101,731	$125,646	$172,400	$223,500	24.2	19.1
Public Safety	175,525	235,778	234,252	255,500	421,500	45.7	24.5
Public Works	53,199	110,106	57,845	95,000	184,307	20.0	36.4
Health & Sanitation	5,776	3,650	5,936	4,050	7,550	.8	6.9
Culture and Recreation	21,717	30,365	22,390	34,500	59,350	6.5	28.6
Contingencies					26,000	2.8	—
TOTAL EXPENDITURES-EXPENSES	$367,282	$481,630	$446,069	$561,450	$922,207	100.0	25.8

3.13.5.4 Eureka County. Eureka County is in the position benefitting most from the growth in mining exploration and production. Much of the actual mine production with associated property tax and net proceeds revenues is occurring in Eureka County; however, only a fraction of the associated socioeconomic impacts have affected Eureka County.

Revenues. The two primary sources of revenue in Eureka County include property taxes (including net proceeds) and intergovernmental revenues. These two sources comprise over 93 percent of all revenues in Eureka County. Property tax receipts have grown by 392 percent since 1985-86 and have an average annual growth rate of 49 percent. Intergovernmental revenues have not grown quite as fast, averaging an annual growth rate of 29 percent for a total increase of 181 percent during the same period. Total revenues have averaged an annual growth rate of 34.9 percent.

Expenditures. Government expenditures in Eureka County have had a hard time keeping up with revenue increases. Over the period 1985-86 to 1989-90, expenditures have increased by 173 percent with an average annual growth rate of 28.6 percent. Highway and street expenses represent 35 percent of total general fund expenditures, followed by general government activities at 34 percent; public safety accounts for 13 percent of general find expenditures.

General government spending has averaged an increase of 38.5 percent annually followed by highways and streets at 27.1 percent, health and recreation at 20.9 percent, and public safety at 20.6 percent. It appears that since very little new population has moved into Eureka County, the bulk of the tax dollars have been expended on capital infrastructure. Impacts to public facilities, services, and schools from mining development have been minimal; therefore, Eureka County has not required increased staffing or new facilities or schools. Table 3-26 shows revenues and expenditures for Eureka County from 1985-86 to 1989-90.

Eureka County has a 1989-90 assessed valuation of $421,992,094. The county has no outstanding debt which leaves a debt margin of $42,199,209.

TABLE 3-26

EUREKA COUNTY REVENUE AND EXPENDITURE ANALYSIS
1985-1986 TO 1989-1990

	1985-1986 Actual	1986-1987 Actual	1987-1988 Actual	1988-1989 Estimated	1989-1990 Budgeted	1989-1990 Percentage	Average Annual % Increase (Decrease)
Revenues							
Property Taxes	591,816	1,067,412	1,267,111	2,059,013	2,913,856	48.4	49.0
Taxes	20,832	22,793	23,764	73,713	113,294	1.9	52.7
Licenses and Permits	4,962	4,110	5,766	5,560	5,570	.1	2.9
Intergovernmental Resources	966,852	1,215,691	1,474,478	1,437,386	2,713,622	45.1	29.4
Charges for Services	120,516	177,021	269,547	230,400	161,500	2.6	7.6
Fines and Forfeits	19,393	22,345	18,480	17,000	9,000	.2	(17.5)
Miscellaneous	96,427	114,392	136,690	116,764	105,200	1.7	2.2
TOTAL REVENUES	1,820,798	2,623,764	3,195,836	3,939,841	6,022,042	100.0	34.9
Expenditures-Expenses							
General Government	465,938	583,038	833,788	2,246,600	1,715,821	33.8	38.5
Public Safety	318,128	331,544	382,481	468,500	673,713	13.3	20.6
Judicial	171,293	174,007	191,127	259,650	339,000	6.7	18.6
Highways and Streets	675,573	491,531	657,548	1,015,000	1,762,000	34.7	27.1
Health & Sanitation	116,750	160,747	135,863	149,000	252,500	5.0	21.3
Welfare	2,996	396	126,708	137,700	205,300	4.0	20.9
Culture and Recreation	96,079	145,644	—	—	60,000	1.2	—
Contingencies/Other	9,185	—					
TOTAL EXPENDITURES-EXPENSES	1,855,942	1,886,907	2,327,812	4,295,450	5,074,334	100.0	28.6

3.13.6 Transportation

The Betze Project site is accessible primarily from the south via the county road from Carlin. The road is two-lane, asphalt from the I-80, central Carlin interchange to approximately the Carlin mine. It is an unusually wide gravel surface road from there north to the project site. The paved section is in fair to poor condition; the gravel segment is very well maintained. Traffic on the road, measured just north of I-80, has reflected mainly the level of mining activity, as dispersed recreation and non-mining activity generate only light traffic in the area north of Carlin. Average daily traffic counts varied up and down over the past decade with a general upward trend, ranging from 235 vehicles per day (vpd) in 1978 to 680 vpd in 1987 for an average annual increase of 11 percent. There was a dramatic increase in 1988 as traffic tripled to 2,110 vpd; 1989 traffic increased only slightly to 2,215 vpd.

The City of Elko experienced substantial increases in traffic on city streets as the population grew through the 1980s. Although traffic generally declined from 1978 to 1981, it has steadily increased since 1982. Traffic on Idaho Street near 12th Street averaged 23,670 vpd in 1989, 68 percent higher than the 1978 level. Traffic at other locations on Idaho Street has not increased as much but overall levels are notably higher than they were in the late 1970s.

In response, the city is implementing an extensive series of planning and street improvement projects. A master plan for traffic management and improvements was prepared in 1987, however traffic levels projected for 2,000 were generally exceeded by 1990 (Williams 1990). Consequently, a new master plan is proposed for the 1991-1992 fiscal year. In order to accommodate traffic increases, the city is conducting a major improvement program designed to relieve Idaho Street congestion and improve traffic flow across the river. East-west improvements include a frontage road, Ruby View connector north of I-80, new Silver Street, and Downtown Corridor connections, and improved signalization and channelization for Idaho Street. North-south access has been improved by the state's 4-lane widening of the Lamoille Highway to Spring Creek and by a new bridge across the river.

Local funding for street improvements comes from revenue bonds supported by the regional transportation (gasoline) tax and by general obligation bonds).